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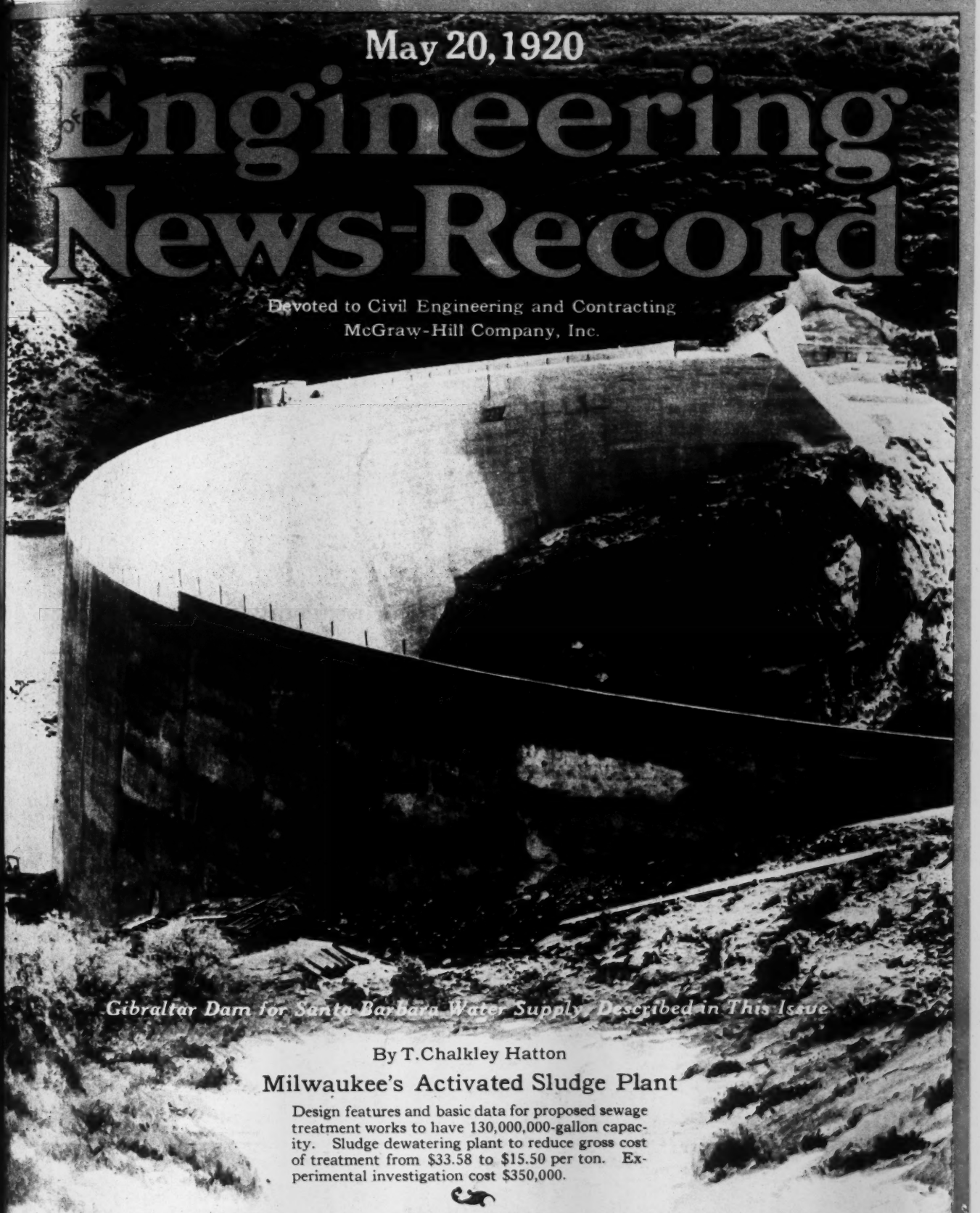

Gibraltar Dam for Santa Barbara Water Supply Described in This Issue

By T. Chalkley Hatton

Milwaukee's Activated Sludge Plant

Design features and basic data for proposed sewage treatment works to have 130,000,000-gallon capacity. Sludge dewatering plant to reduce gross cost of treatment from $33.58 to $15.50 per ton. Experimental investigation cost $350,000.

By H. A. Foster

Triangulation Simplified by Army Co-ordinate System

By Prof. S. H. Gray

A College Course in Highway Inspection Methods

By E. W. Lane and E. L. Chandler

Measuring Upward Pressure Under a Masonry Dam

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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A Seaport a Mile High

"THE billion-dollar Great Lakes-Tidewater project, which would almost make a seaport out of Denver," is under discussion in the shadow of Pikes Peak, according to a Denver newspaper. Even allowing a few thousand feet elevation to be expressed in that word "almost," there still should be quite a job here for the designers and builders of locks.

Upstream Blankets for Dams

UPWARD pressure on dams having porous foundations has been more a matter of theoretical consideration than of actual test. For that reason the experiments carried out at Dayton, and noted on another page, are valuable though they are somewhat inconclusive. Their best value is the indication of the tightening effect of an upstream blanket. Whether the lengthening of the "line of creep" reduces pressure proportionately or not, the final mud jetting operations in the test showed that the silt deposited above the dam effectively served to keep water away from the bottom of the dam. That fact may be used, if necessary, to justify the mechanical placing of such a blanket if it is feared that it will not be automatically deposited in a short time.

Small Bridge Foundations

DURING a recent spring flood four small bridges went out in one New York county. Each bridge was fairly modern and each had a superstructure of admirable design and sufficient strength for modern loads. In every case the foundation was vulnerable against underwash, that potent weapon of the flood. Old and obvious as is the lesson here, the concentration of failures makes it well worth repeating. No structure is stronger than its footing, and where that footing is subject to attack, as it always is in a bridge, more care can well be bestowed upon it than upon the more obvious superstructure. In large bridges the foundation is always watched, but in the many small crossings which are a part of all roadwork, too frequently the major attention is given to loads and stresses on the truss or arch, and the footings are considered only enough to see whether they will safely bear that load under normal conditions. In small bridges, particularly, watch your footings.

The New York Section

WITHIN the few weeks since its organization the New York section of the American Society Civil Engineers has gathered together a membership of 248, making it the largest of the local sections of that society. At its first annual meeting, held last week, proposals were made through special committee reports which, when carried out, will make it a contender for the place of the most business-like and progressive of all the sections. In proposing dinner meetings, over by 9 p.m., the New York section cannot fail to increase its membership and add to the interest of its sessions. In agreeing to join, in several meetings during the year, with the local branches of the other founder societies it evinces a broad social co-operative spirit. The New York section, though containing in its membership many whose faces are familiar at meetings of the society at large, has no national character, nor wants one. Its opportunities for service are local. Its beginning is auspicious.

The Hen and the Egg

IN proposing, at the recent annual meeting of the National Highway Traffic Association, that the question of equitable loads allowed to motor vehicles be considered at some future meeting, one of the members of the association foresaw the destruction of a vast mileage of highways unless drastic action were taken to limit to the least destructive load the weight of truck and contents. After several minutes of futile discussion another speaker analyzed the situation as being analogous to the question: "Which came first, the hen or the egg—the highway or the motor vehicle?" For the better part of an hour champions of the hen and champions of the egg defended their respective theories and the annual meeting ended with an exclamation from one member that "we can now consider the egg scrambled." Highway transport is not a single responsibility. Its efficiency depends not solely upon the highway engineer nor the automotive engineer but upon their hearty co-operation. It is just as harmful to limit the axle weight of trucks by laws based upon the present condition of roads—except of course as a temporary measure—as to expect that highway departments will respond to every caprice of automobile design. Highways must, however, be considered as only a means to an end: that end, national transport. It is just as necessary to pass regulations governing the nature and the strength of roads as to pass regulations controlling the weight and speed of the vehicles using them. The future highway must be constructed with regard to its use by self-propelled vehicles, and the automotive engineer, because of the heterogeneous types of road surfacing, must design and construct reasonably light vehicles capable of carrying its required load at minimum cost. Until that co-operation has produced its results enforcement of maximum load regulation is a necessity. Not all heavy haulage operators are as farsighted as is George H. Pride, who has said that owners of commercial motor lines will bring about their own destruction by truck overloading. Connecticut and New Jersey, the two Atlantic states that have suffered most, perhaps, in the breaking up of their roads this spring, have found drastic regulation essential. And regulation will be necessary as long as 14-ton loads pound over highways of light design

Lessons from A. A. E. Convention

DELEGATES to the convention of the American Association of Engineers at St. Louis last week represented a constituency, many of them with definite instructions, and it was this back-home constituency that ruled the meeting regardless of new light which the delegate got from the debate on the floor or from the small group conference. Lesson 1, then, is the danger of the instructed delegate. More time spent in the choice of a delegate and less in debate on what he shall stand for in detail is essential, leaving to him the freedom to exercise his best judgment on all except broad principles.

This leads to lesson 2, which is the distinct evidence shown of a desire to decentralize all duties that can possibly be handled locally. Even though the work can be done more efficiently at headquarters, the home chapter wants to handle its own money and its own affairs, leaving to headquarters only the duties of national importance.

Few conventions are able to muster a quorum before 10:30 a.m., but this one was scheduled to start at 8 a.m. on the second day. A quorum was present twenty minutes after that time, which is the best of evidence that a responsive membership back home had made its impress so strongly and seriously upon the delegate that he was willing to work three sessions a day without murmur, if only he could better serve the interests of his fellow engineers.

The A. A. E. delegate was not particularly interested in what other societies were doing. He did not comment on the action of his board of directors in accepting the invitation to the Organizing Conference in Washington. Not even in cloak room discussion did the matter have much attention. The consistent ignoring of the existence of A. A. E. by the other national societies has been met, as heretofore, by attendance strictly to its own business of handling welfare and other non-technical work. There was not expressed any antagonism against the technical societies; rather sympathy and encouragement for their upbuilding into still stronger positions.

Analysis of the choice of officers indicates that A. A. E. members have an appreciation of the fact that men in the midst of their active careers make the best executives. The youngest official, a director, was graduated more than 10 years ago, the next 14, and then, with the exception of one out of college 35 years, on up to the president who graduated from Massachusetts Institute of Technology in 1892. Every officer is a graduate; two hold high positions in government service; one is chief engineer of a state utility commission; one is a city water-works managing engineer; one is a consulting engineer; one a college professor; two are railroad valuation engineers, and one a first assistant railroad engineer. Two only are from Chicago, and the remainder are scattered over the country from Washington, D. C., to Portland, Ore. Altogether the A. A. E. would seem to have a well-officered national organization equipped to co-ordinate the efforts of its rapidly growing membership into a force for upbuilding the non-technical interests of all engineers and to assist engineers everywhere in fulfilling those civic responsibilities which education and experience place at their door. With 17,000 earnest members led by able officers much may be accomplished before the association delegates meet a year hence.

A Transportation Crisis

WHEN an official representative of the railroad executives issues a statement that "the food and fuel situation is assuming threatening proportions" as a result of various factors contributing to a general transportation shortage, there seems little doubt that a crisis in transportation has occurred. With railroad development virtually at a standstill for four years, the transportation system of the country has been unable to withstand the shock of a tremendous volume of business following closely on the heels of a labor upheaval. Additional track facilities and the equipment necessary to afford a proper factor of safety cannot be supplied for so long a time that temporary remedy must be sought in radically altered operating methods. To this end the American Railroad Association has asked the Interstate Commerce Commission to invoke the drastic priority powers which are granted by the recent Transportation Act, since the railroad companies cannot legally enforce the blanket priority orders and embargoes that seem necessary to relieve the congestion.

The construction industry is so seriously affected that the keenest interest will be taken in developments of the next few weeks looking to a solution of the most serious traffic blockade since 1917. The volume of work that is in progress and planning for the immediate future—particularly highway work—is great enough to tax the normal capacity of the railroads in transporting materials. Now, an almost universal shutdown is threatened.

Embargoes are onerous, but they must be faced until the situation is relieved. It is evident that the railroads cannot continue to accept new business at the normal rate and at the same time clean up the blockade. This policy, with embargoes against the acceptance of freight from foreign lines, is in large measure immediately responsible for the present situation. Such competitive methods of railroad business-getting, harking back to the "good old days," cannot succeed in this crisis. A broader view of the situation must be taken by the private traffic managements or it will not be possible to give the public adequate and satisfactory service. This, after all, is the ultimate test of private operation, which this journal and its predecessors have always favored. We believe, however, that the railroad managements have become thoroughly alive to the danger of failure, now that the executives have made application to the commission for taking such drastic steps to prevent a complete breakdown. There is reason to believe that the shortsighted competitive methods of interline embargo and similar practices will quickly be abolished, and we hope that the present emergency will result in their permanent and enforced abandonment.

At best the situation can be but slowly relieved and industries far down in the priority lists must make plans accordingly for transporting their materials as best they can. What this means to the construction industry was learned during the war. That industry represents such a large volume of shipping that it is by no means powerless to act as a unit against such old-fashioned methods of competitive railroad operation as the interline embargo. Now a crisis has occurred and it must be faced by shippers and railroad companies alike.

Activated-Sludge Moves Forward

MILWAUKEE will be written in the annals of sanitary engineering as the first large city to commit itself unreservedly to the activated-sludge process of sewage treatment. Its action has been neither blind or hasty. It has shown wisdom in using plenty of time, money and expert skill in preliminary studies and in working-scale experimentation before making detail plans for the construction of a plant designed to treat ultimately a dry-weather flow of 130,000,000 gal. of sewage. Its caution has been one of wisdom rather than of timidity because a considerable portion of the time and energy put upon activated-sludge studies at Milwaukee has been for the purpose of determining how best to design the different elements of the plant and combine them into a harmonious whole rather than to reach a decision as to whether this particular process of sewage treatment should be adopted.

The extended article on the basis of design for Milwaukee's activated-sludge plant submitted in this issue by T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, is designed, according to the author's own statement, to answer the many questions pouring in upon Mr. Hatton from every part of the world regarding this epoch-marking project. Taking into account the necessary limitations of space in an engineering journal, Mr. Hatton's article may fairly be considered as one of the most important contributions ever made to the literature of sewage treatment. With remarkable compactness and clearness Mr. Hatton not only outlines the design of the plant, together with its main objects and its promises of achievement, but he also correlates these facts and opinions with the data gathered from the experiments and from other sources. Articles of this sort are all too rare.

It is no disparagement of what has been decided upon at Milwaukee, nor of the activated-sludge process in general, to urge that because Milwaukee has decided to put in a sewage treatment plant of the type indicated it does not follow that any other given city should do so. The whole study, the conclusions reached and the plant design based upon them illustrate anew and forcefully the remarkable extent to which local conditions—including particularly character of sewage and the environment of available sites—govern and should always govern the method of sewage disposal chosen for any given city. At Cleveland and also at Worcester, Mass., where in each case extensive tests of the activated-sludge process have been made, the experimental data, in the light of governing local conditions, were held to be against the activated-sludge process. What the governing conditions are at Milwaukee is clearly pointed out at the beginning of Mr. Hatton's article. These conditions are worthy of careful study by any one having a sewage-disposal problem to solve in order that he may determine to what extent the particular local conditions confronting him toward or away from the activated-sludge process.

That an activated-sludge plant intended, like this one for Milwaukee, to produce an effluent of high character and marketable fertilizing material is complex and expensive will be evident to any one who gains from Mr. Hatton's story a complete picture of the works that have been designed for Milwaukee. But to offset the heavy capital and operating expenses, Mr. Hatton is counting on a large revenue from the sludge. It should also be noted that at Milwaukee any other process of treatment available to meet local conditions could by no possibility be placed upon the small site available so that heavy additional capital charges would have been entailed for an outlet sewer leading to some other site.

In the minds of a not inconsiderable number of engineers there are still doubts as to the mechanical and commercial practicability of recovering the fertilizing value in the sludge from this process. It is true that various and long continued experiments with sludge dewatering have been made at Milwaukee, but that portion of Mr. Hatton's article dealing with the dewatering plant seems to indicate that finality has not yet been reached, even from the viewpoint of design. If we turn from the sludge-handling experimental plant at Milwaukee to the much larger working plant being built at Houston, Tex., it appears that, after many months of remodeling, the Houston dewatering apparatus was at last accounts still in the hands of the contractor awaiting the completion of further changes. When the Houston dewatering plant is finally accepted by the city we shall still have to await some months or perhaps a year or two of daily operating service before we can be sure that a mechanically and commercially successful dewatering plant has been achieved.

Another element in the utilization of sludge from activated-sludge plants is the marketing of the product. There is little experience to go on here. However, it does not seem too much to hope that not only will all the mechanical difficulties in connection with sludge dewatering yet be overcome, but also that, once a satisfactory dried sludge is produced, at least the better governed of our municipalities will be able to cope with the selling problem. It must be remembered that the cities handling activated-sludge must not only be able to market their products, but also to operate their plants with such efficiency as to produce a salable material that has not cost far more than it will bring in the market. If it be urged that this is a problem in municipal government rather than in sewage engineering, it may then be answered that the two are inseparable.

The words of caution and of questioning in some of the preceding paragraphs are not intended to lessen the high degree of credit due to the Milwaukee Sewerage Commission, its engineering and other technical staffs and advisors. They are intended rather and only to put other cities and other engineers on their guard lest, on the strength of the Milwaukee studies and conclusions, these other cities and engineers should venture too boldly in adopting the activated-sludge process without first having taken every reasonable step to make sure of its local availability.

Finally, the activated-sludge process remains, as it has been since its development was first given attention a few years ago, one of the most if not unqualifiedly the most promising method of sewage treatment of the many that have come to the front in the last three decades. If other cities will follow the example of Milwaukee and make equally careful and skilful studies of the process before adoption, design their plants in accordance with the lessons thus derived, operate them with equal skill and then record, interpret and present the results in like manner, there is much reason to hope that this new process will take a leading place among the available methods of sewage treatment.

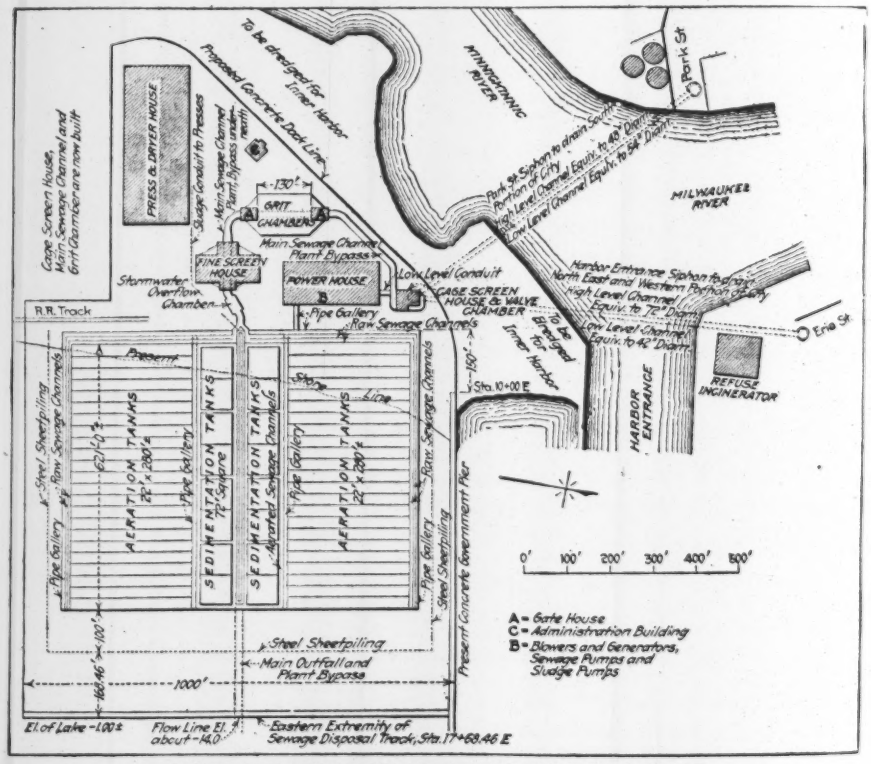
Activated-Sludge Plant for the City of Milwaukee

Plans Adopted for 85,000,000 Gallons of Sewage in 1930 and 130,000,000 in 1950—Bar Screens, Grit Chambers and Fine Screens Precede Activation—Sludge Acidified, Pressed and Dried for Fertilizer

By T. Chalkley Hatton
Chief Engineer, Sewerage Commission, Milwaukee, Wis.

Inasmuch as statements have been printed that, after many years of investigation, the Sewerage Commission of the City of Milwaukee has abandoned the intention of building a sewage disposal plant of the activated-sludge type, it may be of interest to readers of *Engineering News-Record* to know that the contrary decision has been made by the Commission, the reasons for such decision, the characteristics of the plant now being designed and the basic data governing the design—the latter compiled from what has, perhaps, been the most exhaustive investigation by any municipality of a sewage treatment process.

As early as August, 1917, the Sewerage Commission reached the conclusion—from the experiments it had conducted for two years—that the activated-sludge process was best adapted for treating the sewage of Milwaukee. Before undertaking such a large expenditure (about $5,000,000) for what was practically an experimental process, it was considered good policy to call in the services of a consulting engineer especially qualified to pass judgment upon the report of the chief engineer, and the character of the data upon which this report was based, to ascertain what, if any, changes should be made in the recommendations embraced in said report. For this purpose, Harrison B. Eddy was engaged with the distinct understanding that his studies and findings were to be restricted to the activated-sludge process—the commission being convinced, from the results of the experiments conducted under its direction on other well known methods of sewage treatment, and its knowledge of the peculiar governing conditions existing in Milwaukee—that the activated-sludge process was the only one which would meet these conditions in a satisfactory manner.


To be dredged for Inner Harbor
Proposed Concrete Dock Line
Menominee River
Park St.
Park St. Siphon to drain South Portion of City
High Level Channel Equiv. to 48" Diam.
Low Level Channel Equiv. to 54" Diam.
Milwaukee River
Cage Screen House, Main Sewage Channel and Grit Chamber are now built
PRESS & DRYER HOUSE
Sludge Conduit to Presses
Main Sewage Channel Plant Bypass under
GRIT CHAMBERS
Main Sewage Channel Plant Bypass
FINE SCREEN HOUSE
POWER HOUSE
Low Level Conduit
CASE SCREEN HOUSE & VALVE CHAMBER
Harbor Entrance Siphon to drain North East and Western Portion of City
High Level Channel Equiv. to 72" Diam.
Low Level Channel Equiv. to 42" Diam.
Erie St.
Stormwater Overflow Chamber
R.R. Track
Pipe Gallery
Flow Sewage Channels
To be dredged for Inner Harbor
Sta. 10+00 E
HARBOR ENTRANCE
REFUSE INCINERATOR
Present
Steel Sheetpiling
Pipe Gallery
Flow Sewage Channels
AERATION TANKS 22'x 280'
SEDIMENTATION TANKS 72' Septone
SEDIMENTATION TANKS Aforetime Sewage Channels
Present Concrete Government Pier
0' 100' 200' 300' 400' 500'
A = Gate House
C = Administration Building
B = Blowers and Generators, Sewage Pumps and Sludge Pumps
Main Outfall and Plant Bypass
1000'
El. of Lake -1.00±
Flow Line El. about -14.0
Eastern Extremity of Sewage Disposal Track, Sta. 17+68.46 E

GENERAL LAYOUT OF ACTIVATED-SLUDGE SEWAGE-WORKS FOR MILWAUKEE, WISCONSIN

After a very careful and painstaking study of all the data available from the experiments made under the direction of the Sewerage Commission, Mr. Eddy reported, the latter part of 1917, that it was inadvisable to proceed with building the plant in accordance with the chief engineer's recommendations until further investigations had been made, and suggested that a small plant be constructed on the lines recommended and operated for a year to demonstrate the possibilities of the process.

Following this suggestion, the Sewerage Commission rebuilt its experimental plant with a view of determining many points more closely than they had theretofore been determined, equipping it with the most modern measuring appliances obtainable—which had not been done in the first investigations—and operated the plant continuously for over a year with a fluctuating flow of sewage corresponding to that which will govern the operation of the final plant. As a result, Mr. Eddy has reported that the activated-sludge process will best meet the Milwaukee conditions, and the Sewerage Commission, by formal resolution, has adopted it and directed the chief engineer to prepare final plans and specifications to the end that a plant may be completed as promptly as possible.

The peculiar conditions which influenced the engineers in recommending, and the Sewerage Commission in adopting, the activated-sludge process as the best method of treatment may be briefly stated as follows: The Milwaukee water supply is taken from Lake Michigan through an intake located approximately four miles

from the harbor entrance through which nearly all the sewage of the city finds its way to the lake. During southeast winds, this sewage reaches the intake in a few hours. To the south and north of the harbor entrance, the public bathing beaches are located, which thousands of bathers daily use from three to four months of the year.

The city has begun an extensive development of its harbor, the ultimate value of which might be considerably nullified through sewage contamination. The logical site for a sewage treatment plant is at or near the harbor entrance, the apex of the three watersheds upon which the city is built. This site must be upon land to be recovered from the lake in from zero to 14 ft. depth of water, and at best only 35 acres can be thus recovered, the balance of the lake front having been unalterably condemned for harbor purposes. And last, but by no means least, the general topography of the city and the surrounding country presents no available site for the disposition of sludge without creating a nuisance which would, without doubt, be estopped either by litigation or legislation.

Milwaukee's Threefold Sewage Problem

The threefold problem to be solved in determining the best type of sewage treatment consisted of (1) producing a clear effluent from which from 90 to 95 per cent of the bacteria had been removed and which would be stable for at least three days; (2) the final disposition of the sludge by such a method as would not cause a nuisance to the citizens, the lake users or to the suburban neighbors; and (3) finding a type which could be contained upon the least area.

This was the reason for the persistent efforts upon the part of the Sewerage Commission to investigate the activated-sludge process in such detail and the large expenditures made therefor, which have exceeded $350,000 (including costs for experiments conducted upon other types of treatment) and which, so far as the writer knows, are the most extensive investigations ever made by any one city in any one line of municipal improvement. In passing, it might be well to state that the investigations as a whole have embraced grit chamber operation, fine screening, Imhoff tank sedimentation, trickling filters with varied depths of stone beds, chlorination, colloidal slate filters similar to the one tried out at the Lawrence Experiment Station under the direction of Henry Clark, electrolytic chlorination without lime, chemical precipitation, the draw-and-fill aeration process, mechanical disturbance with air applied for oxidation only, reaeration of sludge, sludge drying, sludge dewatering by several types of filter presses, sludge drying by artificial heat, acidifying sludge for dewatering and settling, and numerous other minor investigations.

The ultimate plans which have been tentatively agreed upon and prepared embrace the following features which are given in sequence as the sewage passes through the plant:

DAILY FLOW OF SEWAGE TO BE PROVIDED FOR, GALLONS

Date	Average	Average With Storm Water	Maximum	Maximum With Storm Water
1922	65,000,000	67,000,000	98,000,000	147,000,000
1930	85,000,000	86,500,000	128,000,000	165,500,000
1950	129,000,000	130,000,000	193,000,000	231,000,000

LOW-LEVEL SEWAGE TO BE PUMPED, GALLONS

1922	30,500,000	31,000,000	460,00,000	51,000,000
1930	33,500,000	33,500,000	50,000,000	55,500,000
1950	40,000,000	40,000,000	60,000,000	65,500,000

These quantities represent the ultimate capacity for which the plant is being designed, but the grit chamber and fine screening plant are being designed to provide a maximum capacity of 321 m.g.d., which is the capacity of the intercepting sewers reaching the disposal plant. This extra 100 m.g.d. storm flow is expected to reach the plant during 400 hr. of the year, and will flow through the grit chamber and fine screens only, after which it will be chlorinated and by-passed into the lake.

One third of the sewage, amounting to an average dry weather flow of 40 m.g.d., daily, reaches the plant at El. —25 and is termed the low-level sewage; the balance, amounting to 90 m.g.d. reaches the plant at minimum El. + 8.50. The low-level sewage first passes through cage screens with vertical bars spaced 2 in. apart (not staggered); thence to three 30-m.g.d. electrically-driven centrifugal pumps automatically controlled, the motors being of the variable-speed type, controlled by electrical contact from a float built in the suction well. These pumps deliver the low-level sewage into the main conduit, where it joins the high-level sewage after the latter has passed through a grid screen with vertical bars spaced $3\frac{1}{16}$ in. apart.

Grit Chamber Followed by Fine Screens

The conduit delivers the sewage to a grit chamber built in eight parallel and similar compartments controlled by sluice gates actuated by hydraulic cylinders, and is designed to provide for a flowing-through velocity of from 0.64 to 1.0 second-feet.

From the grit chamber, the sewage is conducted to the fine screens which are designed in units, with brass or manganese bronze plates slotted with $\frac{3}{32}$ in. by 2 to $2\frac{1}{2}$ in. openings, mechanically cleaned by brushes, and which are to have a capacity of passing 130 m.g.d. of dry-weather flow under a 4 in. loss of head, and 321 m.g.d. of dry-weather and storm flow under a 12 in. loss of head. The screenings are to be delivered upon a common belt conveyor available to each unit.

The screened sewage passes into and through the aerating tanks which are to be approximately 340 ft. long, 22 ft. wide and 15 ft. effective depth, built in parallel, with filtros diffusion plates built in gutters at right angles to the direction of flow and 4.5 ft. between centers.

Thickeners To Be Used in Sedimentation Tanks

From the aerating tanks, the mixed liquor, containing the sludge and liquor, flows into conduits which deliver it to the several sedimentation tanks, which are to be built in parallel, 72 ft. square on top, 72 ft. in diameter on bottom and 15 ft. effective depth, with a bottom slope of approximately 18 in. Each of these tanks is to be equipped with a Dorr thickener or similar device for continuously and uniformly removing the precipitated sludge to a central outlet in the bottom.

The clarified liquor flows over weir troughs built across the top of the sedimentation tanks at such intervals as to provide for a maximum flowing-through velocity of 1.5 ft. per minute, and the effluent passes direct into the conduit carrying it to the lake near the harbor entrance in 14 ft. depth of water. The sludge is removed from the sedimentation tanks by hydrostatic head, over adjustable weirs, and flows through an open aerated conduit to a junction where a part (apportioned by will of operator) flows direct

to the filter press pumps, and the balance to the return-sludge pumps. The latter are electrically driven and automatically controlled and deliver the return sludge into the screened liquor conduit where the two mix, are aerated while passing through this conduit, and together reach the aerating tanks.

Tanks to Carry 18 Per Cent Return Sludge

The control of the plant is largely centered in the junction separating the excess from the return sludge. The aerating tanks are designed to carry, under normal conditions, 18 per cent of return or activated sludge; they can carry 50 per cent without in any way interfering with the process. During Sundays and holidays, when the press and drying plants are shut down, there will be no excess sludge, all being returned through the plant at an approximate additional rate of 12,000 gal. per 1,000,000 gal. of sewage.

The excess sludge passes into a small suction well where sulphuric acid is added to assist in dehydrating it and to which a stuff pump is connected. This pump forces the sludge through a piping system which supplies the filter presses under the required pressure, which is automatically regulated. The filtrate from the presses flows by gravity back to the low-level sewage well where it mixes with the raw sewage and passes through the plant; the sludge cake, containing approximately 80 per cent moisture, is deposited upon a button conveyor operating under each press, which takes it to a main belt conveyor which carries it through the press house to a storage tank in the center of the dryer house.

The screenings from the fine screen conveyor are delivered to and pass through a set of steel rolls which reduce the moisture from 85 to about 80 per cent. They are then conveyed by a belt conveyor underground from the screen house to the press house where they are delivered on the sludge cake conveyor with the sludge cake and carried to the storage tank in the dryer house. The screenings from the coarse screens are to be pressed in the cider press type of press in common use and transported to the sludge cake conveyor. A grab bucket, operated by an electric hoist moving on an overhead mono-rail, carries the mixture of screenings and sludge cake to a small hopper located in front of each dryer from whence it is carried by screw conveyors into the dryer.

The dryers are to be continuous, revolving and of the direct or direct-indirect heat type, coal or oil burners, depending upon the type of boilers to be used in the adjacent boiler plant. They are to be 60 ft. long by 82 in. in diameter, each capable of producing one ton of sludge containing 10 per cent moisture per hour from sludge cake containing 85 per cent moisture and evaporating 8 lb. of water per pound of combustible.

From the dryer, the dried product is conveyed by bucket conveyor to a shaker screen, 10 meshes to the inch, the residue passing to a mill which grinds it, delivers it to the bucket conveyor and back to the screen. The fine sludge which passes through the screen is conveyed to a series of storage hoppers holding about 10 days' output. These hoppers terminate in square bottoms to which bags are attached and through which they are filled. These bags stand upon weighing scales arranged to automatically cut in the feeding valve and to record the number and weight of bags filled.

From the scales, the bags are carried by a bag conveyor to the car loading platform or to a storage house. Conveyors are also to be provided to carry the dried product to cars or boat for shipment in bulk.

The grit accumulating in the grit chamber will be removed, as demanded, by means of a ½-yd. clamshell bucket worked on the end of a 50-ft. boom operated by a 10-ton locomotive crane moving on tracks on either side of the grit chamber, this boom being of sufficient length to span four chambers. The bottoms of these chambers are protected from damage from the bucket by steel rails laid 15 in. apart and ½ in. above the concrete bottom, and the top edges of the division walls are protected against like damage by 6 x 6-in. timbers securely anchored to the walls. The grit is to be deposited back of bulkheads to make up land adjacent to the future docks, and when this means of disposal is no longer available, it will be loaded upon cars and deposited outside of the city.

Ten Thousand Horsepower Air Requirement

The type of power plant has not yet been decided upon; that is, whether it shall be a steam or internal combustion engine plant, and if steam, whether the fuel used will be coal, powdered coal or crude oil. Specifications are in preparation for all types, and proposals will be invited covering each, whereupon the decision will be made to adopt the type which seems to promise the greatest economy. The ultimate power requirements are as follows:

	Hp.
For low-level centrifugal pumps	805
Blowers for compressing air and auxiliaries	10,057
Generators for operating miscellaneous motors for all purposes connected with the process	973
Total power required in 1950	11,835

The entire plant, including buildings, coal storage, tanks, etc., for the 1950 period will cover about 22 acres, 17 of which are to be recovered from the lake.

The basic data upon which the entire plant has been tentatively designed, and which have been prepared from the results of the experiments conducted during the past five years, are as follows:

The screenings collected by the coarse screens are estimated to be 0.022 cu.yd. or 0.02 ton per 1,000,000 gal. of sewage, this estimate being based upon records taken for several years' operation of a 4-in. spaced rack screen placed across the old intercepting sewer which carries the present sewage to the experimental plant.

Grit Chamber and Fine Screen Design

While a temporary grit chamber was built and operated for over a year, passing a daily flow of 11,000,000 gal. at a velocity ranging from 0.64 to 1.12 ft. per second, no reliable records of the amount of grit which could be expected from the entire city flow of sewage could be obtained. For this purpose, the grit records of the plant at Rochester, N. Y., for 1918 and 1919, as furnished by N. A. Brown, superintendent, have been assumed as fairly representing what we may expect at Milwaukee. The Rochester records give an average of 2.03 cu.ft. of grit collected per million gallons of sewage, and range from 4.05 cu.ft. in March to zero during May, July and November. During the first nine months of 1919, the average was 2.52 cu.ft., ranging from 5.40 cu.ft. in July to zero during February and March. For the Milwaukee plant, 2.30 cu.ft. per million gallons have been assumed. This represents an average daily deposit in the 1950 period of 11 cu.yd. and would

fill the sedimentation compartment of one chamber in seven days.

Band screens having manganese bronze plates slotted with ¼-in. slots 2 to 2½ in. long, cut transversely with the line of flow, moving at the rate of 10 ft. per minute and with plates slotted with $\frac{3}{32}$-in. slots, 2 to 2½ in. long moving at the same speed, were operated throughout 1919. These screens were cleaned by brushes revolving at a peripheral speed of 60 ft. per minute in the direction the screen moved.

When a constant loss of head of 2 in. was maintained on the ¼-in. screen, with the raw sewage containing 350 p.p.m. suspended matters, a 16 weeks' constant run gave 129,435 gal. of sewage passing through the screen per square foot of wet area, from which were collected 1017 lb. of screenings at 85 per cent moisture per million gallons of sewage. The slots represented about 27 per cent of the total plate area.

When a constant loss of head of 4 in. was maintained on the ¼-in. screen with the raw sewage containing an average of 295 p.p.m. suspended matter, 246,000 gal. per square foot of wet screen area passed, and 472 lb. of screenings containing 86 per cent moisture per million gallons of sewage were collected. This run was made from July 19 to Aug. 30, 1919.

Screens With $\frac{3}{32}$-in. Slots Adopted

From Sept. 9 to Nov. 30, 1919, a continuous run was made with the $\frac{3}{32}$ in. slots with a constant 4-in. loss of head; 449,290,000 gal. of sewage were passed from which were collected 277,800 lb. of screenings containing 87.2 per cent moisture. The raw sewage contained an average of 277 p.p.m. of suspended matters. That is, the screenings collected amounted to 618 lb. per million gallons of sewage and the screens passed 195,300 gal. per square foot of wet area. The $\frac{3}{32}$-in. slots occupy 24.6 per cent of the plate area. The above experiments showed that the ¼-in. screen would pass about 20 per cent more sewage and collect 30 per cent less screenings than the $\frac{3}{32}$-in. Aside from this, the indications were rather pronounced that the $\frac{3}{32}$-in. screen permitted the screened effluent being treated at a higher rate per acre, which means less contact period between air and sewage and consequently less area for aeration tanks. The $\frac{3}{32}$-in. slots were adopted.

The natural query arises, Why not introduce much finer screens and thus increase the rate of treatment per acre? The answer to this, as we have seen the conditions here, is that the sludge resulting from too fine screens, is impracticable to dewater because it contains insufficient coarse matters to afford vehicles by which the water can be led from the interior of the sludge cake to the filter cloths. For instance, sludge containing considerable hair dewaters much quicker than one with less hair. To one who observes the pressing of sludge, it is quite apparent that the coarser the mass forming the cake, the dryer it is and the quicker it becomes dry.

Better Results with Tanks 15 Feet Deep

After operating two 15-ft. and two 10-ft. deep aerating tanks in parallel from Nov. 4, 1918, to March 15, 1919, it was found that the 15-ft. gave rather better results than the 10. As the 15-ft. tanks required less area of plant, the balance of the demonstration run was made with the tanks operating in series, the 10-ft. tanks being used primarily to produce sufficient sludge to supply the presses and dryer. (See table.)

CHARACTERISTICS OF SEWAGE TREATMENT IN AERATING TANKS 15 FT. DEEP THROUGH SEVERAL PERIODS OF 1919

Characteristics	3/16 to 5/11	5/25 to 6/22	6/22 to 9/28	9/28 to 11/2*	1/1 to 12/28 1919
Free ammonia, p.p.m.	11.4	15.1	14	...	14.1
Oxygen consumed, p.p.m.	31	30	29	...	31
Dissolved oxygen, p.p.m.	6.8	4.5	5.6	4.8	5.7
Nitrites, p.p.m.	0.59	0.62	2.23	0.88	0.89
Nitrates, p.p.m.	0.60	0.41	1.13	0.24	0.55
Per cent of sludge in tanks	18	18	18	16	18
Per cent of sludge returned	13	20	19	17	18
Gal. ret'd sludge per 1,000,000 gal. sewage	131,200	193,000	191,400	171,500	178,000
Per cent of water in ret'd sludge	97.4	97.7	98	97.7	97.5
Gal. waste sludge per m.g.s.	8,831	12,020	13,270	13,040	12,447
Cu.ft. air per gal. of sewage	1.49	1.52	1.47	1.17	1.44
Air pressure, in lb.	7.07	7.16	7.20	...	7.08
Contact in hours	6.53	5.23	4.88	5.16	5.33
Million gallons treated per acre	15.7	18.5	20.1	25.5	18.5
Per cent bacteria removed, 20°	95	98	98	96	97
Per cent bacteria removed, 37°	97	99	99	97	97.4
Per cent suspended matter removed	97.9	98.7	99	97.7	98.2
Stability in hours	120	115	119	103	113
Suspended matter in raw sewage	265	276	313	270	303
Per cent suspended matter removed by screens	3.7	3.2	2.9	3.7	3.7

* The special run from Sept. 28 to Nov. 2, was made to ascertain whether standard effluent could be maintained during peak load in tanks without increasing the air applied. Analytical records not taken after Sept. 30.

To better understand this test, it should be stated that the plan adopted for operating the plant is to apply a uniform volume of air to the tanks throughout the 24 hr. at a rate of 1.5 cu.ft. of air per gallon of sewage, based on the average flow. During low night flows, when the sewage is diluted, the contact period will be increased and the rate of air per gallon of sewage passing will of course, exceed 1.5 cu.ft. per gallon. Contrariwise, during the peak load of the day, the contact period will be greatly diminished as will the rate of air applied per gallon. During the night flow, the activated sludge passing through the tanks will be so greatly strengthened as to provide ample biological treatment for the peak flow, and the above tests seem to amply prove this assumption.

Increase of Air Pressure on Filtros Plates

At this point it may be well to call attention to the slow and gradual diminution of the efficiency of the filtros plates which is shown by the increased pressure of air. This pressure started on Jan. 1 with 6.9 lb. and was 7.21 lb. on Sept. 30 when the records were no longer taken. This condition existed in spite of extreme precautions taken to clean the air passing to the plates, which consisted of drawing the air through one layer of 16-oz. duck, and another layer of canton flannel, and washing it by a hydro-turbo blower of the Nash type. The tanks have not been emptied since Nov. 4, 1918, and therefore no examination of the plates has been made.

The present plant, so far as the aeration and sedimentation tanks are concerned, is being planned to provide for the treatment of sewage up to the 1930 period. If the assumptions prove excessive, as the tests indicate, it simply means that this period can be extended without extensions to the plant. We have therefore designed the aeration tanks for a 6-hr. contact period for the average dry-weather flow and the application of 1.5 cu.ft. of air per gallon of average dry-weather flow.

Attention should be called to the strength of the sewage treated during this demonstration, as indicated by the suspended matters recorded. This is due to the fact that the intercepting sewer, which delivers the sewage

to the testing station, carries a very large proportion of industrial wastes—much greater than will be obtained at the plant when all the domestic sewage is added. This condition will, undoubtedly, reduce the air and contact requirements as well as the amount of excess sludge to be handled.

In a continuous run of four months with two 15-ft. tanks in parallel, one having 1 sq.ft. of filtros plate area to 4.4 sq.ft. of tank area, and the other 1 to 6, the former showed so much better results that a 1 to 4.5 ratio has been adopted.

Study of Sedimentation of Aerated Sewage

The problem of sedimentation received much detail study. Four sedimentation tanks were built with 15 ft. effective depth; two 11 ft. square and two 9 ft. square on top, and of corresponding diameters on bottom. Through each vertical foot of each tank, a pipe with a hand cock was screwed, and for four months samples of the tank liquor were drawn every hour throughout the 24 and allowed to settle in graduated cylinders. During this period, the liquor was passed through the tanks at different rates per day and per week and curves of sedimentation plotted from the settlements shown in the cylinder.

These investigations, while interesting in many other ways, conclusively indicated that sedimentation could be satisfactorily effected at the rate of from 1,800 to 2,000 gal. per square foot of tank area; that the flowing-through velocity should be confined to 1.5 ft. per minute, and that 15 ft. was a minimum depth when treating the ordinary fluctuating flow of sewage. This fluctuating flow caused the fine sludge zone to rise from 2 ft. during low flow to 13 ft. during peak flow, above which it would not go when the flow was at the rate of 2,000 gal. per square foot or less.

The design is based upon 1,600 gal. per square foot, providing for the maximum dry-weather flow at this rate, and a maximum running-through velocity of 1.5 ft. per minute.

Hour's Settlement Gives 98 Per Cent Sludge

It is important to remove the settled sludge from the sedimentation tanks as it settles, and at the same time to give it a little time to separate itself from much of the water. Should the sludge be removed as fast as it accumulated, the resulting moisture would be from 99 to 99.5 per cent, whereas an hour or more of settlement will reduce this to 98 per cent, a much less quantity to handle. This feature is obtained by allowing from 2 to 3 ft. depth of sludge to remain in the tank above the plow which is moving at a constant speed below this mass and plowing the thicker sludge to the center outlet. The speed of this plow should not exceed 13 ft. at the periphery and the plows should be so set as to draw pretty uniformly from the entire bottom. The plow used by the testing stations was made by the Dorr Co., New York City, and has been a very satisfactory device.

As previously stated, the sludge is drawn from the sedimentation tanks by hydrostatic head through hand-controlled submerged weirs. It discharges into an open conduit, the bottom of which contains filtros plates through which the air enters the sludge in sufficient quantity only to keep it from settling while flowing to the junction, where the excess sludge is divided from the return sludge. This is an important feature because activated sludge will quickly settle when moving at a velocity of less than 2 ft. per second, and soon becomes septic, which in turn destroys its dewatering properties.

A special experiment was conducted from March 16 to June 15, 1919, to determine the volume of sludge produced in the 15-ft. tanks. With sewage containing 273 p.p.m. of suspended matters, 157,000 gal. of return sludge and 12,100 gal. of excess sludge were produced per million gallons of sewage. During this period, 18 per cent of sludge was retained in the aerating tanks and about 13.5 per cent returned. Both the return and the excess sludge contained 97.5 per cent moisture.

Upon this basis, the plant is being designed and provides for pumping a daily average of 13,433,000 gal. of return sludge for the 1930 period, and 20,250,000 gal. for the 1950 period, and for dewatering and drying 1,028,500 gal. of sludge during the 1930 period and 1,560,900 gal. for the 1950 period.

The excess sludge will flow to a stuff pump designed to operate automatically from the pressure in the pipe delivering the sludge to the presses. The service for 1930 will be 357 gal. per minute minimum; 714 gal. average; and 1,076 gal. maximum. Two pumps will be installed.

Sulphuric Acid to Assist Dewatering Process

The sulphuric acid for assisting in dehydrating the sludge will be discharged into the stuff pump well. It will be arranged to be applied automatically with the speed of the pump, feeding on an average of 4.5 c.c. per gallon of sludge. It is important that this acid should not be allowed to remain in the sludge too long. There should be some free acid when the sludge reaches the presses.

We now come to the most important problem of the activated-sludge process, the dewatering of the sludge. Experiments to this end have been carried out for four years with three types of presses and two types of centrifuges, with numerous kinds of filter cloths, plates, screens, racks and feeding devices and, although the sludge has been dewatered by means of every device used, it is felt that improvements are still possible which will solve this problem better than we have been able to solve it so far.

The sludge comes to the presses containing from 97 to 98 per cent of water and must be reduced to 80 to 85 per cent before it can be economically dried. Its character changes considerably from day to day and this has more or less influence upon the dewatering process. The main requirements which must be met to practically solve the problem are: Time of pressing, stability of filter cloths, clean cloths when cake is dumped, stability of plates or racks, maintaining free drainage in plates and racks and reducing labor to a minimum. True, these requirements are more or less interdependent, but each must be considered.

The centrifuges used were not at all successful from the start, and were abandoned. The two types of presses which have given the best result are the plate press made by the Simplex Co., Chicago, and the platen press, manufactured by the Worthington Pump & Machinery Co. of New York City, and known as the Berrigan press.

Eleven-oz. duck cloths were used, and the cloths were

washed down with a hose stream four times during the run, and even so each pressing showed a diminution of cake produced, indicating that the bags would have to be removed, thoroughly washed and replaced every second day if the press efficiency was to be maintained.

A sample run of the Simplex press is as follows:

Number of pressings	8—continuous
Number of plates	10
Effective size of plates	33x33 in.
Sulphuric acid	5.2 c.c. per gal.
Time of pressing (complete)	4 hr. 9 min.
Moisture in wet sludge	97.6 per cent
Moisture in cake	82.7 per cent
Pounds of cake	3,710
Pounds per sq. ft. filter cloth	3.06

A sample run of the platen or Berrigan press, when using burlap bags, is as follows:

Length of run, two pressings a day	3 days
Number of bags	10
Effective size of bags	41x72 in.
Sulphuric acid used	4.5 c.c. per gal.
Time of pressing complete	4 hr., 31 min.
Moisture in wet sludge	98 per cent
Moisture in cake	81.7 per cent
Pounds of cake per pressing	1,363
Pounds of cake per sq. ft. filter cloths	3.38

Because the methods for filling this press are not well adapted to its type, it is estimated that at least 20 minutes can be cut off the time of pressing, allowing 4.5 hr. for the entire operation.

Burlap Bags Give Best Result in Platen Press

While the burlap bags are fairly clean after each operation, their efficiency can be increased by slightly washing them down with a hose stream after each operation. The burlap bags have given the best results in the platen or Berrigan press; they drain freely, are easily washed, appear to be as stable as duck bags and cost about one-fortieth as much. They are not adapted to the plate press.

Experiments are now being conducted with the type of filter plate made by the John Johnson Co., Brooklyn, N. Y., and the Worcester plate, as used in the sewage disposal plant at Worcester, Mass.

The Berrigan press, as it is being designed, will contain 22 racks and bags, 72 x 48 in.; will be fed under a uniform pressure of 10 lb., and will use 200 lb. per square inch when pressing. It is assumed that it will produce 3 lb. of cake per square foot of filtering area and make five pressings per 24 hours. If the Berrigan press is used, the press layout will provide only for the 1922 period—for 65,000,000 gal. of sewage per day. This will require 38 presses for active use and four additional ones for spares. These will be installed in units of 12 each because two men can attend to this many on a shift.

Weights of Dried Sludge and Screenings

It is estimated that from the 785,500 gal. of excess sludge at 97.5 per cent moisture produced daily in 1922, 668,500 lb. of sludge cake at 80 per cent moisture will be produced. Our experiments on drying have indicated that this sludge cake, when reduced to 10 per cent moisture, will weigh just 25 per cent of the cake, so that the daily output of dried sludge from the sludge cake will be approximately 83.5 tons. In addition to the sludge cake, the screenings must be dried. In 1922, these will amount to 24,100 lb. at 80 per cent moisture or to 5,300 lb. at 10 per cent moisture.

The propositions submitted by two reputable dryer manufacturers are practically equal, so far as output is concerned. Briefly, they are that with a 60-ft. by 82-in. dryer, 5,000 lb. of water per hour can be evaporated, and that it will require 1 lb. of combustible to evaporate 10 lb. of water. This will require five dryers for 1922 period and nine dryers for the 1950 period. The former number is now being provided for.

To reduce the odors arising from the drying of the sludge, the gases are drawn through a dust chamber and from thence through a spray washer where the soluble gases are removed with the water which flows back to the low-level sewage well. This method has been tried out at the station and found satisfactory.

For the purpose of briefing the foregoing information, the following summary of data upon which the Milwaukee sewage disposal plant is being designed, is submitted.

Average dry-weather sewage to be treated, 1922, 65 m.g.d.
Average dry-weather sewage to be treated, 1930, 85 m.g.d.
Average dry-weather sewage to be treated, 1950, 130 m.g.d.
Coarse screenings collected from 3/4-in. and from 2-in. wide openings, in grid and cage screens, respectively, 0.022 cu. yd., or 0.02 tons per 1,000,000 gal. of sewage.
Grit to be disposed of, 2.3 cu. ft. per 1,000,000 gal. of sewage.
Fine screenings from 3/32-in. slots, 4 in. average loss of head, 618 lb., at 87.2% moisture p.m.g. of sewage.
Excess sludge produced, 12,100 gal., having 97.5% moisture, p.m.g. sewage treated, or 102,850 lb. (specific gravity, 1.02).
Sludge cake produced 10,083 lb., having 80.3% moisture, p.m.g. sewage treated.
Dried sludge produced, 2,521 lb., having 10% moisture, p.m.g. sewage treated or 1.26 tons.
Press will produce 3 lb. of cake per square foot of filter cloth in 4.5 hr., or 5 operations per day of 24 hrs.
Dryers will reduce 6,700 lb. sludge cake at 80% moisture to 10% moisture, and will evaporate 8 lb. of water per pound of combustible.
Depth of aeration tanks, 15 ft., effective.
Depth of sedimentation tanks, 15 ft., effective.
Contact period based on average dry-weather flow, 6 hrs.
1.5 cu. ft. of air per gallon of sewage based on average dry-weather flow, which includes air applied at all points.
Air to be applied at a constant volume throughout the 24 hrs.
Pressure of air, 7 lb.
Sedimentation based on 1,800 gal. sewage per square foot of tank area based on 4.5% nitrogen as ammonia recovered from dried sludge.

Engineers can well appreciate the hesitation with which the author submits any estimate of the cost of construction or operation of such a plant under the existing problematical future conditions influencing such costs, but he feels that this article would incompletely answer the queries of many interested engineers should this phase of the subject be entirely omitted, and so cost estimates are given below, based on the best and most recent information available.

In comparing these estimates with the cost of other disposal plants treating sewage by different processes, it should be considered that the Milwaukee plant must be built upon recovered land, the cost of which exceeds a half million of dollars; that all structures must be supported upon pile foundations wherein 25- to 40-ft. piles are to be driven on 4-ft. centres; and that the cost of materials and labor is from 60 to 100 per cent more than pre-war costs.

Gross and Net Annual Costs

The estimated cost of building the plant for a capacity of 85,000,000 gal. per day (1930 period) is $5,000,000. A considerable portion of this cost covers the requirements for the 1950 period, or 130,000,000 gal. per day, but assuming this entire cost to be chargeable to the lesser capacity, the annual cost is estimated to be $33.58 per million gallons of sewage treated, which embraces capital charges of $14.07 and operating costs of $19.51 per million gallons. These estimates are based upon labor at $4 per 8-hr. day; electric current, 7.5 mills per kw-hr.; coal, $4.75 per net ton; filter bags (burlap), 20c each, and 12 sets per year per press; 4.5 c.c. sulphuric acid per gallon of sludge at 1c. per pound; one ton of dried sludge per 1,000,000 gal. of sewage; and 4.5 per cent of nitrogen as ammonia in dried sludge, worth $4 per unit. This means that there

are 90 lb. of nitrogen to every ton of dried sludge, not allowing for the 10 per cent moisture remaining in the dried sludge.

From these estimates, it will be seen that the net cost of the treatment, including the $18 per ton return from the dried sludge, will be $15.58 per 1,000,000 gal. of sewage treated, which compares favorably with any other type of treatment producing a comparable effluent.

It is believed that the return from the dried sludge has been conservatively valued inasmuch as the sewage treated in the demonstration plant has produced 1.25 tons of dried sludge per 1,000,000 gal. of sewage and the sludge has contained about 5.5 per cent nitrogen as ammonia, which has been worth, during the war, from $5.50 to $7.25 per unit, and is now quoted at $6.50.

There are many features connected with this process of sewage treatment which it is important to know to insure successful operation of any plant built, but this article has already attained much greater length than its author intended. His purpose of answering briefly the many questions asked him by engineers, concerning the results of our work here in Milwaukee, has been accomplished to the best of his ability with the available data.

The experiments have been ably conducted under the immediate direction of William R. Copeland, chief chemist; the designs are being worked up under the direction of Darwin W. Townsend, engineer of designs; construction is under the charge of James L. Ferebee, principal assistant engineer. Harrison P. Eddy and Will J. Sando are consulting sanitary and power engineers, respectively, and Philip, Eschweiler and Barkhausen, local architects, form the art committee to pass upon the design of the superstructures comprised in the plant.

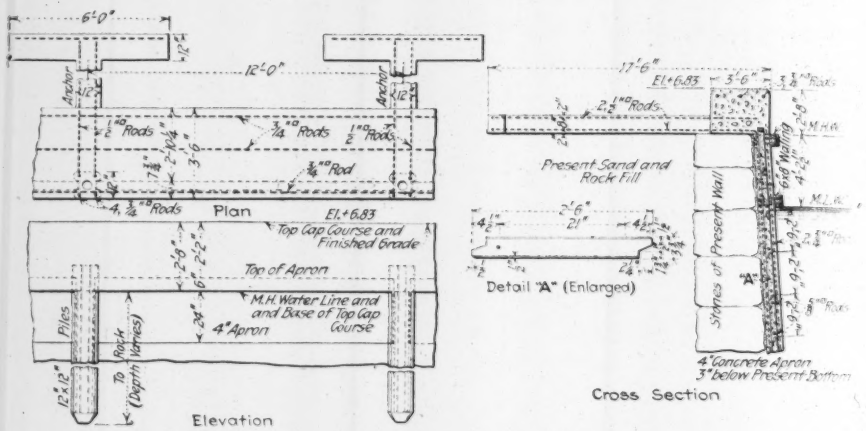
Water Powers in British Guiana

An investigation into the possible development of hydro-electric power in British Guiana has been made by Stafford X. Comber, M. Am. Soc. C. E., and Mr. Comber's preliminary report has been printed by the Government of British Guiana. It records a remarkable piece of pioneer engineering investigation, for Mr. Comber had to proceed alone, at short notice, 150 miles into the vastness of the tropical Guiana Jungle and secure his technical data with the assistance of only a few native Indians. The trip was made during the period of heaviest rainfall ever recorded in the forty years during which records have been kept. The report notes that the total amount of 24-hr. horsepower that could be developed on the three main rivers of British Guiana from natural head, calculated on a basis of 95 per cent at the turbine intake, would probably be about 800,000 hp. It is understood that the provincial government is seriously considering the report with a view to the development of the more important and readily accessible powers revealed by Mr. Comber's investigation.

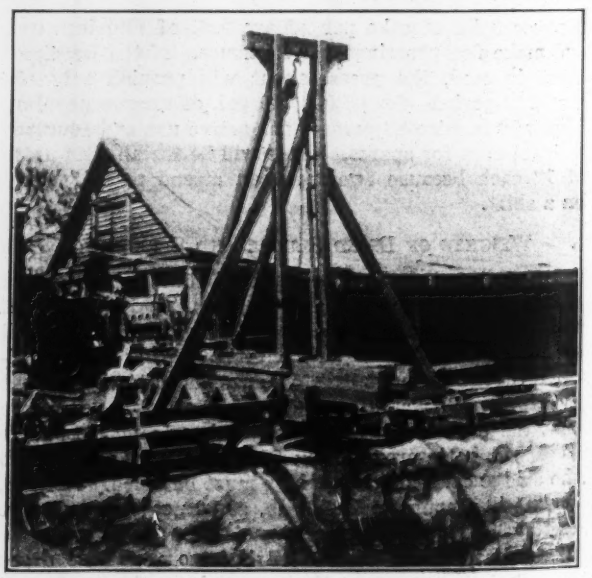
Concrete Facing Placed on Old Masonry Sea Wall

West Indian Stone Quay Wall Protected Against Underwash and Erosion by Precast Pile and Slab Structure

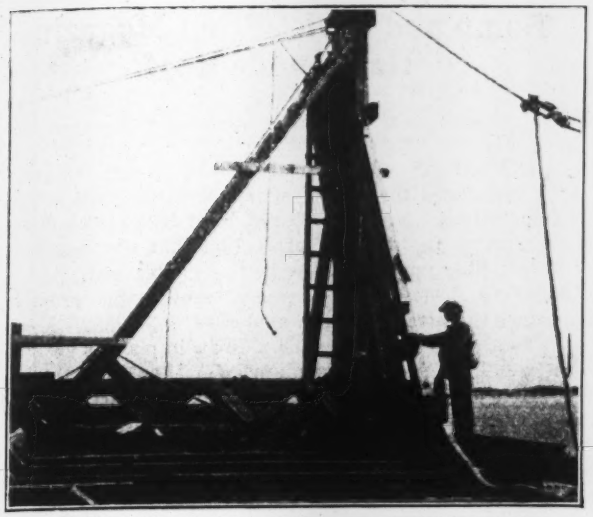
QUAY walls in the harbor of Nassau, British West Indies, have commonly been built of native calcareous quarry stone laid upon the coral sand bottom and backfilled with earth. The stone is comparatively soft and uneven in texture and is rapidly worn away by wave action on the exposed face. Furthermore, the shifting bottom sands are comparatively light and are readily drawn into suspension by propeller suction and the heavy ground surge which is caused by severe northeasters to which the harbor entrance is exposed. In order to stabilize one such wall there has recently been built for the Royal Bank of Canada, in Nassau, a new sea wall in which a complete concrete facing, made up of precast concrete slabs slipped down in the grooves in



DETAILS OF PRECAST CONCRETE FACING PUT ON OUTSIDE OF OLD MASONRY WALL AT NASSAU, B. W. I.



PILEDRIVER MOUNTED ON TOP OF OLD SEA WALL WITH LEADS HORIZONTAL

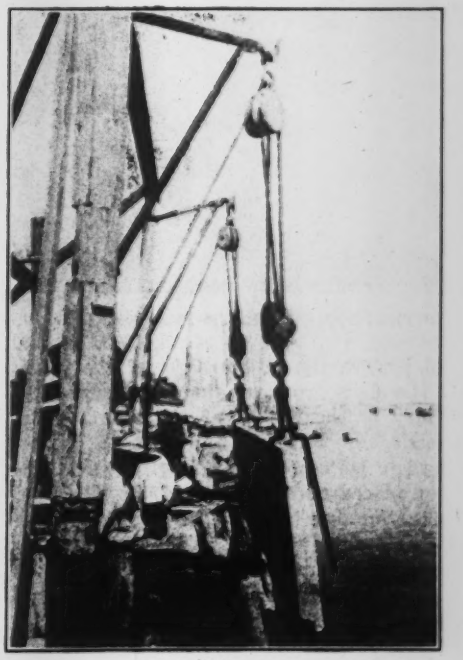


PILEDRIVER LEADS LIFTED TO DRIVING SLOPE

spaced concrete piles and backfilled with concrete, has been used. The new structure was designed and built by Purdy & Henderson Co., under the direction of H. F. Lame as superintendent in charge of the company.

The maximum depth of water at these walls is about 18 ft. at high tide and the sand bottom varies in depth from 4 to 12 ft. overlying a coraline rock which is badly pocketed. At this particular site steel rod soundings showed the coral rock at a maximum depth of 25 ft. below mean high water. The quay is in two sections at right angles, one about 193 ft. and the other, 108 ft. long. The details of the new construction are shown in the accompanying drawing. The precast facing to be erected outside of the existing structure consists of reinforced-concrete piles 12 x 12 in. in section and spaced about 12 ft. c. to c. The reinforced-concrete slabs are 2 ft. 4 in. by 2 ft. 6 in. and 3½ in. thick. They are, as shown, reinforced with ⅜-in. marginal rods and are provided with mating grooves on the long side. They slip down in the grooves of the piles and combine to present on the water side a smooth-concrete surface of sufficient density to resist erosion and protect the embedded reinforcement from sea-water action. Between this space and the existing structure mass concrete is deposited completely filling the intervening space. This is brought to the finished level of the wall forming at the top a heavy beam top course 2 ft. 6 in. deep and 3 ft. 6 in. wide, spanning two panels.

Alternate piles are anchored back to solid earth beyond the line of intersection of the angle of repose of the soil backing with the wharf level, and each pile is dowled 2 ft. into rock at the point, using a 2-in. diameter steel dowel, 4ft. long.



LOWERING THE PROTECTING SLABS IN SPECIAL TONGS

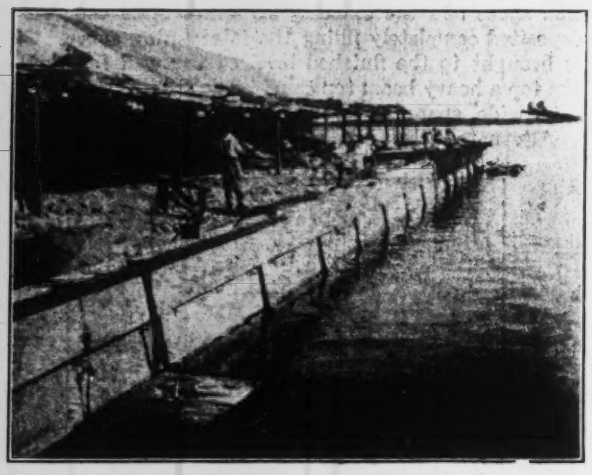
The piles in addition to being slotted on the sides are provided with a central vertical hole, which is used to serve several purposes. Internal curing is carried on by filling the cylinder with water after plugging the lower end of the pile. The holes furthermore decrease weight and serve for jetting. Drilling and doweling were also done from the center of the pile after it was driven, and the hole then was filled with grout.

As the piles had to be spaced exactly and jetted true to line and to a fixed slope it was necessary to devise a special pile carrier and spacer. This is shown in two of the accompanying views. It is a light structure of triangular vertical frame carrying a set of movable leads pivoted at the bottom of the vertical, the whole traveling along a timber framing mounted on the top of the old quay wall. When a pile is to be driven it is slid in from the rear into the leads which are then at a horizontal position. The leads then are swung up to a

PILES DRIVEN ON OUTSIDE SLOPE OF OLD SEA WALL

vertical position through a line fastened to a block and fall at the top of the vertical. The driver itself is mounted on an outrigger and travels on rails set on a timber frame at the top of the wall. The tracks being laid true to line and grade and the lead adjustment being exact, positive alignment of the piles was assured.

Paired outriggers were used in setting the slabs and a special roller frame guide rigged to the outriggers was used to carry the slabs. The roller frame guide



PROTECTING CONCRETE SEA WALL IN PLACE

traveled by gravity in the slots of the piles and prevented the slabs from running unevenly, thus avoiding any injury to the corner of the slabs. Special hooks were made for lowering the slabs so arranged as to permit their being detached from above after the slabs had been placed under water.

The bottom sections of the slabs were jetted into position below the existing harbor bottom. The vertical and horizontal joints were then calked on the exterior face in the concrete backing deposited through a chute in water.

Traffic on British Canals

Strongly as the advocates of inland waterway transport press the case for putting the canal system in a position to handle a larger traffic, it seems to be widely felt that the outlay involved in the improvement schemes which have been put forward cannot be justified by the traffic possibilities. Perhaps the comparatively small expenditure involved in carrying out the scheme outlined in the report which Sir Maurice Fitzmaurice presented to the Canal Control Committee—the approximate cost was £4,000,000—might be authorized, but even this is doubtful. It is admitted that the cost of canal transport has in comparison with the pre-war period increased by about 200 per cent, so that in spite of the increase in railway rates there is still a considerable disparity in the operating costs of railways and canals, particularly in the low-grade traffic which forms the bulk of the leads on inland waterways. A review of the transport situation suggests the conclusion that for the time being at least the railway system can be relieved of only a comparatively small tonnage by the other transport agancies.

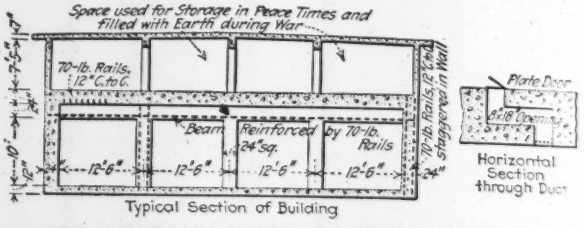
[*From the annual review number (Jan. 1920) of the engineering supplement of the "Times," London.*]

Bomb and Bullet Proof Magazine Has Double Roof

By R. C. HARDMAN
Superintendent, Division of Municipal Engineering, the Panama Canal, Ancon, C. Z.

AIRPLANES and aërial bombs have materially influenced the design of magazines for the storage of explosives. Such structures, built in Panama during the war, exemplifies the protection that now has to be given. The novel feature is the double roof, though the very heavy reinforcement shows the provision against the attack of high explosive.

The structure, which is 54 x 75 ft. in plan, is designed to be bullet-, fire- and bomb-proof, either from the land or air. It is divided into two large compartments for


Space used for Storage in Peace Times and Filled with Earth during War
70-lb. Rails, 12" C. to C.
Beam
Reinforced by 70-lb. Rails
24" sq.
12'-6"
70-lb. Rails, 12" C. to C. Staggered in Wall
Plate Door
Horizontal Section through Duct
Typical Section of Building

EXPLOSIVES MAGAZINE PROTECTED AGAINST AERIAL ATTACK

the storage of ammunition and other high explosives and one small compartment for black powder, etc. Contrary to the usual practice in magazine construction the building has two stories, wherein lies the provision for air protection. The second story is in reality formed by a double roof, the upper 7 in. thick and the lower, which also serves as a floor, being 2 ft. thick. The space between the two roofs is used in peace times for the storage of inflammable but non-explosive materials, and in war times for a filling of earth, sand or similar material.

All walls proper are 2 ft. in thickness and the footings, floor, walls and lower roof are reinforced with scrap 70-lb. steel rails closely spaced. Columns and beams are similarly reinforced. The second story is of ordinary reinforced-concrete construction.

Ventilation of the building is secured by means of zigzag ducts, which permit of the passage of air freely but do not permit of a straight line entrance for small projectiles and similar articles. The outer opening of each air duct is completely covered by a heavy steel plate door and the inner end is provided with closely spaced bars.

All door and window openings in the first story of the magazine are protected by both fire-proof and projectile-resisting doors of heavy plate and angle construction. All doors are placed in recesses so that no direct line of entrance is possible through cracks. Second-story openings are protected by steel plate doors only.

There is no means of access to the second story except by ladder from the outside. Supplies and sand must be placed by a hand hoist moving upon a trolley which slides back into the building when not in use, thereby permitting a tight closure of the door through which it operates.

All artificial lighting is by electricity, the enclosed marine type of fixture being used. Needless to say, the switch panel is placed outside the magazine.

A number of magazines of this general type have been built, all the designing and constructing being done by the forces of The Building Division of The Panama Canal, of which Hartley Rowe was resident engineer, T. C. Morris assistant engineer and the writer engineer-designer.

The Future of A. A. E.

Inaugural Address Delivered May 11, by Le Roy K. Sherman, President, American Association of Engineers, at the Sixth Annual Convention, St. Louis, Mo.

THE reason for the existence of the American Association of Engineers is no longer open to debate. The answer is covered by the fact—10,000 new members in one year. The progress of the A. A. E. in the stream of professional advancement was blocked by the ice of conservatism. The ice has broken. The American Association of Engineers has reached a position of power and numerical strength where no combination can stop the progress in the accomplishment of its ideals. The Association seeks the co-operation and good will of all in the profession.

We are living in the days of readjustment. There is a reaction from the war period of self-sacrifice, generosity, and harmony. The restraint of the individual has been removed and the pent-up combative spirit of selfishness, greed and intolerance has broken into the flames of radicalism. Almost every separate trade, industry, business, or profession today is organized for its material ends. Those individuals or groups which are not so organized are at a merciless disadvantage in obtaining mere equity. They are but pedestrians in the road of reckless juggernauts. Radical thought has not been confined to the trades. We have seen examples of scores of the most highly trained and specialized technical men carried off their feet in one evening's meeting to accept membership and dictation in the closest form of trade unionism. We are not here to discuss the merits or value of trade unionism to the trades; that is for them to decide. It is our province to consider dispassionately the relative advantages and disadvantages of trade union membership for men of the engineering profession or for those young men in the ranks who, by education and ambition, aim to become professional engineers.

Let us note the recorded statement of our Board of Directors:

"We believe in organized representation for the correction of wrong, the advancement of the profession, and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence. The American Association of Engineers recognizing the many fundamental differences between the principles and objectives of the trade union and of an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both."

The Association today has been the means of preventing the exodus of thousands into the alternative of trade unionism. The A. A. E. is conserving the unity and integrity of the profession. For this the thanks and respect of those most honored members of the old school is due to the American Association of Engineers.

In the year ahead, as in the past, the fundamentals for our activities are two-fold. One, the aim to correct the errors and faults of the engineers themselves; the other, to correct or improve the external conditions and the public's relations toward the profession, which limit the opportunities and welfare of engineers and their usefulness to society.

We are beginning to be more candid with ourselves. We will approach perfection more quickly by recognizing our shortcomings. In our training as engineers we have become experts in the use of materials and their relative strengths. We have become masters in the determination of stresses and the utilization and knowledge of the laws of physics and, truly, that is fundamentally engineering. But efficiency is not limited to the acquirement of the best economy of materials; efficiency must include also the study of other relative values. As engineers, our training in the analysis of the strength and use of materials is exactly the training required for solving the problems in relative values, and those are the problems of the executive, the manager, and leader. Therefore let us expand the usefulness of our training to include the factors of relative values and cost. Let us study the human equation and develop the art of constructive imagination. Through efficient service to the public, our clients, our employer, the men we assist will measure our usefulness and our value and thus aid our material compensation and reward.

I am now, and all my life have been, an engineer, although I have held some official titles not designated as engineer. Therefore I am not guilty of heresy when I maintain that the training of an engineer should be a means and not necessarily an end in life's work.

In our relations to the public there are many important matters pending: Equitable compensation of engineers in municipal and railway service; the engineers' license law; a national department of public works; the enactment or modification of proper building laws and laws regarding reclamation and public improvements; the question of professional ethics involved in outside work undertaken by public employees or officials. It should be our duty to aid in the solution of problems involving relations between the public and the various utility companies which are fundamentally engineering work. For example, the removal of onerous burdens on public utility companies which increase cost of operation without resulting in an improvement to the service. The public utilities companies may have sinned against the public in the past, now they have suffered the penalty and they are entitled to redemption.

There will arise other problems during the year, matters for prompt action for the welfare of the profession and its individuals. The greatest potential value of the American Association of Engineers is that they are organized and ready to act in any section of the country promptly and intelligently.

General policies, procedure, and initiative to a large degree must always devolve upon the membership and committees in the chapters. To carry out this work, to attend to the details, to act at the critical time, there is required the services of paid, full-time workers. We have a few of these local secretaries. They are busy men. There should be a representative of the A. A. E. with an open office in every geographical center. They should be under the direct supervision of the national secretary with authority and duty to serve all the chapters within their district. Likewise, there will be required assistant secretaries to devote all of their time to the detailed work in specific lines of activity. Effective service for prompt detail work cannot be had without the man on full time and full pay.

The basic organization of the A. A. E. is correct. It has the two departments, the legislative and the executive. Our legislative department consists of the board of directors and the president, all elected for temporary tenure of office and without pay. The executive department includes the national secretary and his assistants in office and field; all are appointed for continuous service and paid.

We face the coming year with hope and confidence for the future of the A. A. E. We shall have our successes and our disappointments. I am a fatalist to the extent that I believe in the philosophy of "what ought to be will be." It is the philosophy of "Let us believe that right makes might." It is the philosophy of "Trust in God and keep your powder dry."

The following verse is very appropriate, I think:

I hate to be a kicker,
I generally stand for peace,
But the wheel that does the squeaking,
Is the wheel that gets the grease.

Let us not be dismayed but let us take advantage of that trait of American citizenship which, opposed from the outside, binds and unifies the associations of men in the fight for a common cause. In our work for the coming year let us meet this barried and petulant world with the attributes of engineering service she so sadly needs; sane, balanced judgment to govern decisive actions.

Teredos Destroy Piles in Waters Not Previously Infested

After Immunity for at Least 50 Years, Untreated Timber in Upper San Francisco Bays Attacked Vigorously—Repairs Under Way on Many Wharves

WATERFRONT structures in San Pablo and Suisun Bays, which are inland arms of San Fransisco Bay, have always been built on untreated piles because attacks by marine borers were unknown in these waters. Several wharves are still in use in which a majority of the piling is 50 years old. Consternation has been spread in recent months, therefore, by the discovery that teredos are now at work even as far up as the head of Suisun Bay. Within about a year repair and reconstruction work have been started or have been recognized as necessary in practically all untreated pile structures along the extensive shore lines of these two bays.

As early as 1914 teredos were found in dolphin piles in the channel through San Pablo Bay, and also in the breakwater on the south end of Mare Island (which had then been in place four or five years). The piles attacked, however, were in deep clear water where the tidal currents were strong. No record could be found of any borers having been discovered as long ago as that near the shores. The water near shore in many places being comparatively shallow, less salty and often muddy, due to wave action in the tide flats.

The first discovery of full-grown teredos and extensive teredo action close in shore was made at Crockett in structures of the California and Hawaiian Sugar Refining Co. early in 1917. This company was then about to start extensive new work on their wharves. Before construction was actually under way, however, they found a good deal of their piling being attacked vigorously and accordingly the construction plan was entirely changed so as to use creosoted or concrete piles exclusively. In addition to revising plans for the new work, they found it advisable to replace most of the piles under their wharves and warehouses. Under some of the structures close inshore bulkheads and sluiced-in material to raise the mudline was found to be sufficient.

Soon after the discovery of teredos at Crockett they were found in some other structures in the vicinity. However, these cases of teredo attacks "were not taken very seriously" by owners of wharves on the shores of the upper bays. Certainly at that time it was not believed that borer action would become general in these waters and would be found even considerably farther up. The Southern Pacific Co., for example, pulled some piling at Vallejo Junction expressly for inspection purposes as late as June, 1919, and reported no sign of marine borers.

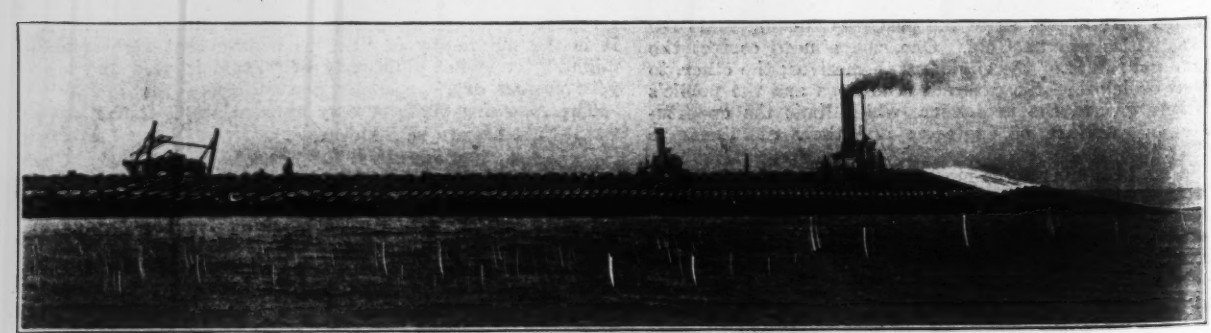
In the fall of 1919, however, discoveries of piling damaged by teredos came at frequent intervals all along the south shores of San Pablo and Suisun Bays. Still more extensive damage was found early in 1920. By this time the seriousness of the situation was realized and thorough examinations were made of all important structures that were supported on untreated piles. By the middle of March the extent of the damage was known and safety measures planned. The situation is apparent from the following résumé of conditions at points along the upper bay shoreline. In all these structures the length given is parallel to shore. Wharves are not ordinarily built out into the channel there.

The Associated Oil wharf about 1,000 ft. long, located at Martinez, was rebuilt with creosoted piles early in 1920 because the piling along the fender line had been entirely cut off by teredos. The tidal currents are swift and the water is deep alongside this wharf.

At McNear's two wharves, a mile below Fort Costa, teredos, were discovered in the piles about Feb. 1, 1920. These structures are 14 and 27 years old respectively. Piles of the latter age in the outer row on a fender line where the water is about 3 ft. deep were found to have been entered to a depth of 2½ in. The remainder of the wharf was in fair condition. The slight penetration here was ascribed to shallow water. On the adjoining wharf which is only 14 years old but where there is 20 to 37 ft. of water along the deep water side, teredos had entirely cut off many of the fender piles. The extent of the damage decreased toward the shore line as the depth became less. Where eddies occurred that kept the water more or less muddy, teredo action was very slight or entirely absent.

The Matson Navigation Co. wharf at Crockett is 135 ft. wide by 1,044 ft. long. No teredo action was discovered in this structure until March, 1920, when 25 piles were pulled in different parts of the wharf for examination. Then it was found that contrary to precedent teredos had attacked the piles even in sections where mudflats were exposed at low tide. The penetration was about 2½ in. in all parts of the structure except along the fender line where the damage ranged from a penetration of 4 in. up to entire destruction of the piles.

The wharf owned by the Selby Smelting Works below Vallejo Junction was found to be in bad condition late in the fall of 1919 when the piling gave way in several places due to teredo attacks. Repair on this wharf is



TUGS RECOVER PART OF FERRY SLIP THAT COLLAPSED SUDDENLY AND FLOATED AWAY

being made by sulicing in material to raise the mudline under the structure.

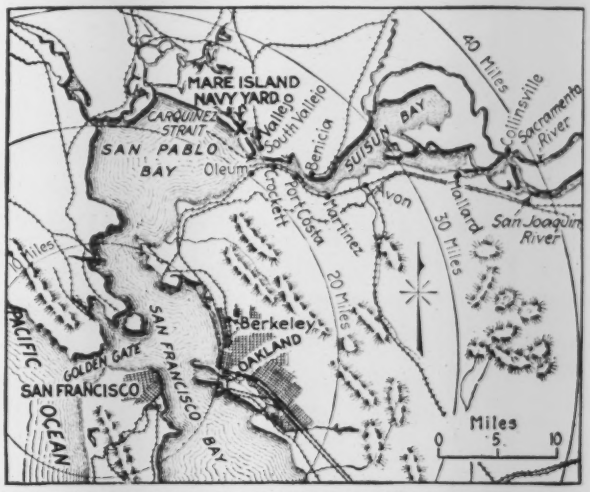
The Sperry Flour Co.'s wharf at South Vallejo has been in service since 1868, supported on untreated piles. It is located in a comparatively narrow channel well away from the tidal currents which sweep through the main thoroughfares up and down the bays. There was no fear of borers at this point until an examination made in the fall of 1919 showed that teredos were in fact in the piles and had penetrated to a depth of about 1 in. Work was begun immediately on a plan for building a dike of heavy material around the structure and filling inside this with dredged material.

Although evidences of the action of pin-head teredos were reported as far up as Collinsville, which is at the mouth of the Sacramento River, the farthest point upstream at which damage has been reported is at Avon. Piles pulled for test purposes recently at Mallard are reported free from teredos.

An example of how unexpectedly the teredo attacks become serious is shown by the collapse of several structures while in service in these waters. A part of the Grangers wharf near Port Costa used for storing grain collapsed in September, 1919, because the pile supports were weakened by teredo action. The owners of the grain brought suit against the wharf owners to recover $10,000 damage for the grain destroyed. At Oleum a considerable length of the Union Oil Co.'s wharf collapsed and fell into the bay in February of this year when piles eaten off by teredos suddenly gave way.

A part of the outer guide wing on the Southern Pacific ferry slip at Port Costa went out with so little warning on Feb. 26, 1920, that men who were fishing from the piles barely had time to escape. The immediate cause of collapse is believed to have been the weakened condition of piles attacked by teredos. The section that went out was 30 ft. wide and about 250 ft. long. Most of the piles in it were over 100 ft. long. An engineer who witnessed the collapse stated

GREEN PILING HONEYCOMBED BY TEREDOS
Unusually complete destruction; piles were pulled after 30 years under boiler house at Crockett, in water 20 ft. deep.



MAP OF SAN FRANCISCO BAY, SHOWING REMOTE POINTS WHERE TEREDO ACTIVITIES HAVE ONLY RECENTLY BEEN NOTED

that the entire length of piling went over gradually and without a sound, evidently giving away under the pressure of the outgoing tide which was running perhaps seven miles an hour at the time.

By way of general comment on the situation as a whole it may be noted that the heaviest teredo action in these waters has thus far been found just at the mudline. Just below the mudline the borings always cease abruptly and from this zone of greatest activity upward the extent of the action decreases rapidly. It has been found that although there is no record of teredos entering a sound creosoted pile standing alone, yet if a piece of untreated wood be spiked to a creosoted pile below water line, the teredo enters the untreated wood and when grown to a length of an inch or more will bore thence through the creosoted pile itself.

In a few of these upper bay structures piles which have been in service about 40 years were driven with the bark on. These are still intact, although others alongside from which the bark was peeled, have been entirely eaten off at the mudline. However, above the water line the bark is subject to rapid destruction by dry rot and below the water line teredos enter the pile if any abrasion or break in the bark occurs. Hard, fine grained fir piles such as were available 40 years ago were used in the construction of these wharves. The progress of teredos in such piles is much slower than in the rapid-growth soft wood now ordinarily sold for piling. In clear salt water where tidal currents are strong, such as has been the condition in the main channel through the upper bays in the past year or two, the sapwood of fir dolphin piles has been penetrated to a depth of 6 in. in three or four months.

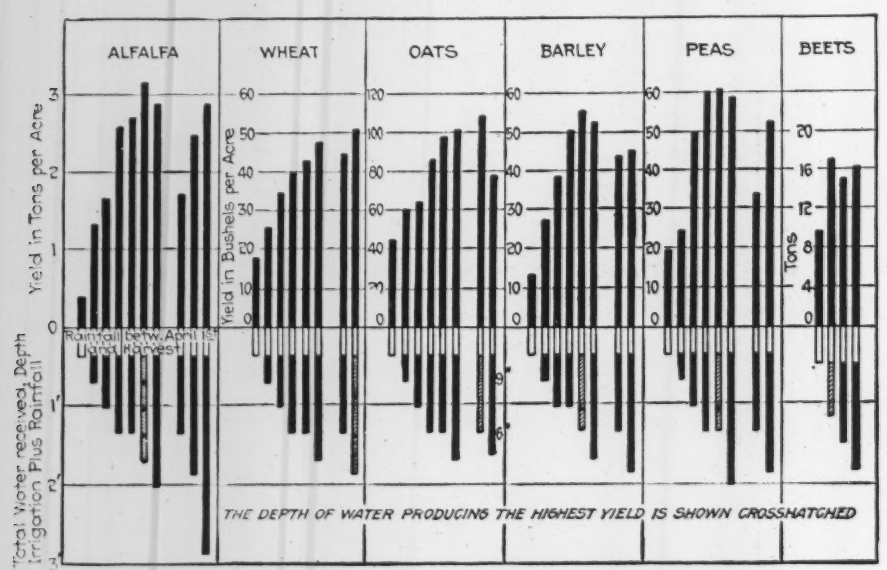
As to the cause of teredo attacks in waters where they have not before appeared, the reasons advanced are that heretofore borers reaching the upper bays have been killed by the annual fresh water floods from tributary rivers. In the past three seasons, however, there has been unprecedented drought, extremely low water and no floods. The dredging and straightening of the channel in the lower Sacramento River, particularly below Rio Vista is also believed to be a factor. As an indication of how conditions have been effected by drought and work on the channel it is pointed out

that the tidal currents in Carquinez Strait have very materially increased in recent years and now run as high as eight miles per hour. Thus structures in which borers have heretofore been killed before they were well started, have in recent years been subjected to unrestrained teredo attacks under conditions highly favorable to their rapid development.

Experiments on Duty of Water in Alberta

Abstract of paper read before the Western Professional Meeting, Engineering Institute of Canada, by F. H. PETERS, M.E.I.C.

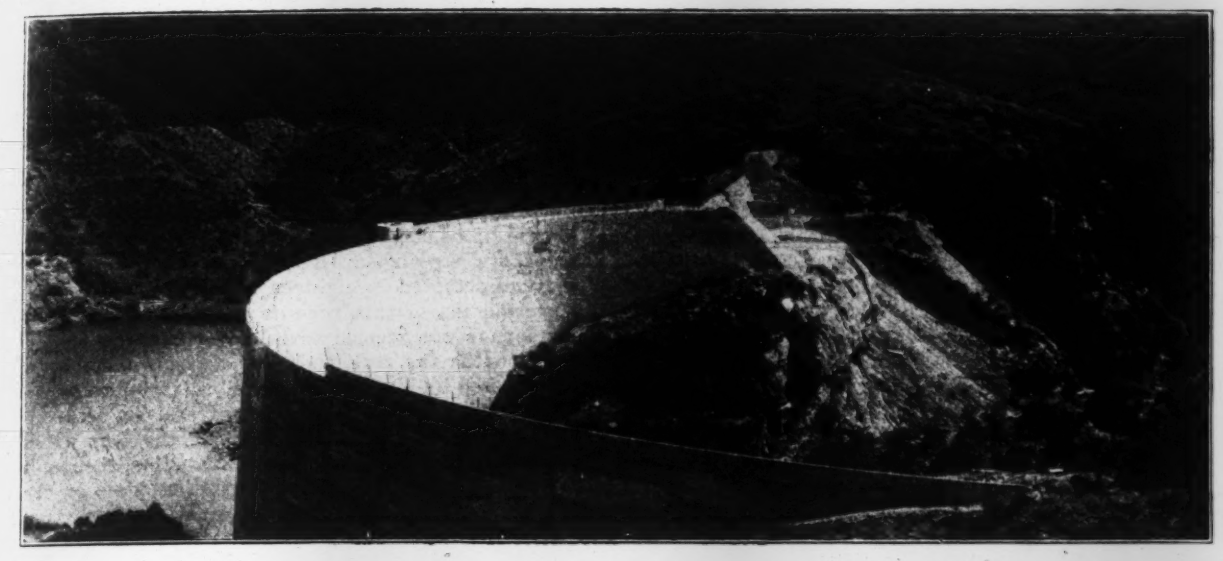
TO determine the amount of water which will produce the largest crop yield was the aim of experiments in 1917 by the Irrigation Branch of the Department of the Interior in Western Canada at Ronalane, Alberta, shown in the diagram. The method of carrying on these experiments is such as to give definite and positive results. A piece of land is selected which has consistent characteristics throughout and this is then divided up into a number of smaller plots. To determine the duty of water for wheat, for example, perhaps ten of these plots are sown to wheat. They are then all treated exactly alike except that varying depths of water are applied. The first plot is left dry; the next receives 4 in., the next 8 in., the next 12 in., and so on up to a point where so much water is applied that the yield is actually decreased. This work is checked by determining from soil moisture investigations the quantity of available water in the soils, both in the spring and in the fall of the year. Sometimes with the deeper rooted plants, the plots which do not receive sufficient irrigation water draw on the available moisture which was in the soil in the spring, and conversely with some of the plots that receive large quantities of water, the plants cannot use all of the water supplied and some of it is stored up in the soil. By determining the quantity of water available in the soil in the spring and again in the fall, just what quantity of water has actually been used by the plants during the growing season can be determined. In the alfalfa crop the first group of columns shows the application of 4 in. irrigations, while the second group shows the results from the application of 6 in. irrigations. Similarly for the wheat, oats, barley and peas, the main group of columns shows 4 in. irrigations, while the last two groups in each case show 6 in. irrigations.



YIELDS ON DIFFERENT PLOTS COMPARED WITH WATER APPLIED

Institutions and Their Councils

NO one who has given any thought to the elections of Members of Council of our engineering institutions can feel satisfied that they are conducted in the best possible way. In the hands of the councils rest the welfare of the institutions, and it is they who are responsible for such progress as the institutions may make, or for such weakness as they may display. Unless, then, members are content to regard the work of these learned societies as complete when they have conferred upon those who are duly elected and pay their annual tolls the right to put certain symbols after their names, the importance of having the right men on the councils is manifest. Yet what do we find? This, that only from ten to fifteen per cent. of the members return their ballot papers, and that the remainder exhibit no interest whatever in the result. This carelessness about a matter of such great importance is deplorable, and on several occasions we have urged that steps should be taken both to awaken members to their responsibilities and to place the elections on a better footing. Much of the indifference is, we are convinced, the result of ignorance. Members do not know why they should elect certain men in preference to others, and hence either vote for none or, worse still, strike out those names nearest the end of an alphabetical list! We have urged that steps should be taken to inform the electors of certain facts. In the first place, where members of councils offer themselves for re-election some indication of the zealousness with which they have performed their duties during the preceding year should be given, and in the second, where new members are nominated, a brief outline of their qualifications should be presented. We do not think this is all that can be done to give life to the elections, but it is the first and most important step. For its recent election the Institution of Automobile Engineers acted on our suggestion, and, we are glad to know that the result is excellent. The ballot papers contained a brief outline of the qualifications of all candidates for the council and a record of attendances—in percentages—at council and committee meetings. Three candidates who never appeared at council or committee meetings were rejected, and in the two cases where men with poor records for attendances were nevertheless returned we have only to glance at their qualifications to find the reason. We congratulate the institution very heartily on this issue. It is particularly gratifying to us because it verifies our anticipation.—*The Engineer*, London.



Gibraltar Water-Supply Dam at Santa Barbara

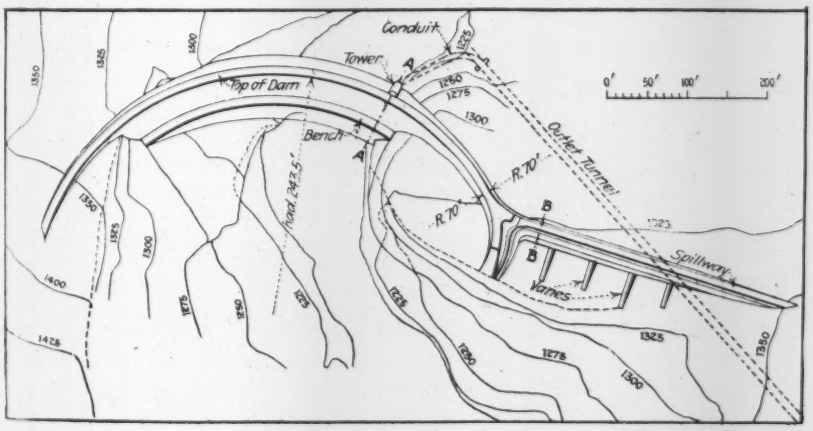
Arched Structure on Santa Inez River Has Artificial Abutment—Surfaces Are Accurately Aligned

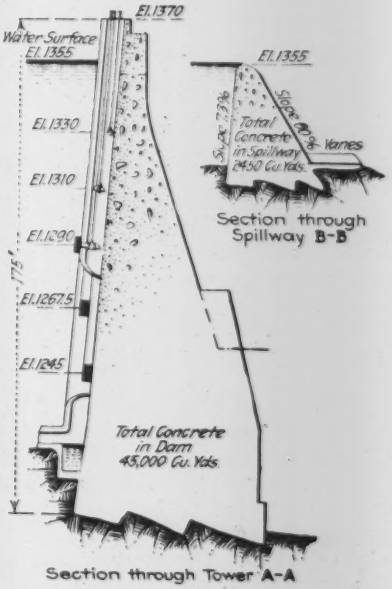
TO PROVIDE storage for its water system the City of Santa Barbara, Cal., has built by contract the Gibraltar dam, an arched masonry structure on the Santa Inez River about six miles east of the city. The damsite is on the far side of a high mountain range through which a 4-mile tunnel, 4 x 6 ft. in cross-section, was driven some years ago to bring water from the Santa Inez River. An account of how all construction equipment and materials for the dam were taken through this small tunnel was published in *Engineering News-Record*, April 3, 1919, p. 681.

The first work at this damsite was done in 1913. At that time the foundations were brought up to the level of the stream bed. The work was resumed on July 8, 1918, when a contract was signed for completing the structure to a total height of 185 ft. above bedrock. The radius on the center line is 238.5 ft. The width varies from 65 ft. at the bottom to 8 ft. at the top and the length, measured along the curve, is 1,100 ft. Because the south wall of the cañon was not high enough, a 3,000-cu.yd. concrete block was poured to take the thrust of the arch on that side. In order to make sure that a solid abutment would be available, this block was placed nearly a year before the main body of the dam was begun. It was pictured and described briefly in *Engineering News-Record*, April 24, 1919, p. 820.

On the side of the artificial abutment away from the cañon an extension of the dam structure in a straight line provides a spillway with its top 10 to 13 ft. below the parapet level, and about 300 ft. in length. The capacity of this spillway is about twice the maximum flood on record. Four concrete vanes parallel with the direction of flow and just below the rollway were put in to prevent the current from cutting across toward the deeper portion of the cañon. The vanes have transverse holes at the lowest point so that the spillway pools, which serve as water cushions, drain out when overflow ceases.

When the water stands at spillway level, it will be 135 ft. deep behind the dam and will form a lake about 4½ miles long containing 16,000 acre-feet. The intake tower, which is built into the upstream face

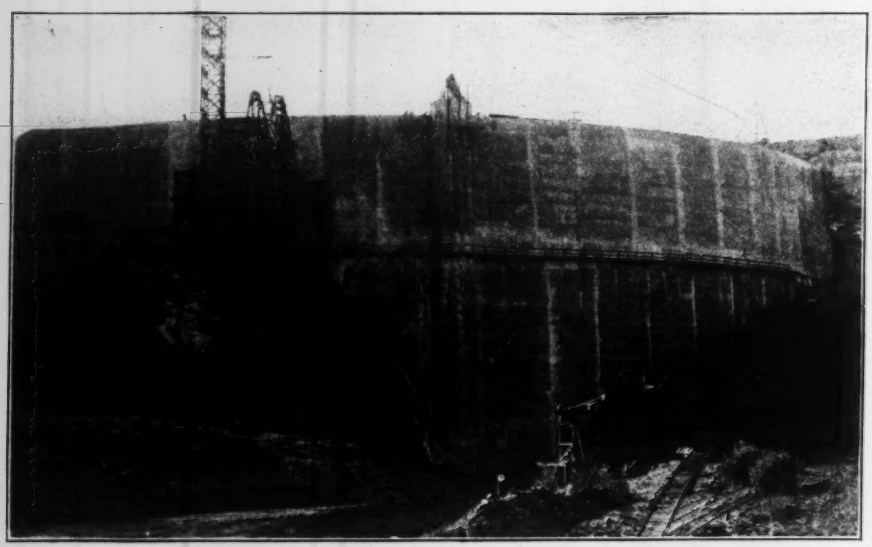




GENERAL DETAILS OF GIBRALTAR DAM, SANTA BARBARA, CAL.

of the dam, has openings for admitting water at five levels, each opening being controlled by a 16-in. valve operated by a hand wheel from the parapet. Screens for these openings, placed on the outside operate in grooves made in projecting ribs of concrete. From the intake tower in the dam water will be conveyed through a 3½-ft. concrete conduit, 200 ft. long to a 900-ft. tunnel. A measuring weir at the lower end of this tunnel was put in so that the quantity of flow can be conveniently gaged occasionally. Below the weir 1,600 ft. of 3-ft. reinforced-concrete pipe connect the line with the north portal of the 4-mile tunnel.

Rock and sand for the dam were obtained from deposits in the stream bed just above the site by a steam shovel and were loaded in 6-cu.yd. cars which were hauled by a gasoline locomotive to the crushing and screening plant located in the river bottom 200 ft. upstream from the face of the dam. After crushing, screening and washing, the aggregate was transported by a 1½-cu.yd. automatic dumping bucket running on a 1½-in. cable to rock and sand bins on the hill above. The location of these bins and the mixing plant and tower with them was given considerable thought because of the necessity for reaching all parts of the curved structure conveniently from the one point of delivery. By building a 185-ft. tower on top of the south wall of the cañon it was possible to get ground anchorages for cables supporting chutes through which gravity delivery was made to all parts of the work with only one change of the cable anchorage. The chutes were set on an angle of about 3 to 1 and delivery was made for a distance of 400 ft. each way from the tower.



UPSTREAM FACE OF GIBRALTAR DAM DURING CONSTRUCTION
Stone crusher in right foreground. Aggregate delivered to concreting plant at left by cableway.

Before concreting was started a reserve supply of 32,000 sacks of cement was brought through the tunnel and stored in a warehouse near the damsite. When concrete was under way the cars carrying 50 sacks each were picked up bodily as they arrived and transported across the cañon to the mixing plant by means of a cableway. The concrete was mixed and delivered to a 30-cu.ft. skip in capacity loads at the rate of one batch per minute, this rate being continued for long stretches at a time without interruption and without cutting the time of mixing below 30 seconds for each batch. Seven men were used in the mixing crew assigned as follows: one man operating bin gates, one man dumping water, operating mixer and giving signals, two men unloading cement from cars, two men dumping cement from sacks into charging hopper, and one man bundling up and tying empty sacks.

A total of 54,000 cu.yd. was poured in spillway and dam (above streambed level). The work was completed and accepted in eighteen months, although during five months of this time no work was carried on. The stoppage was deemed advisable because during the winter months the rock and sand deposits were ordinarily covered by high water. The contractor was particularly careful in securing alignment of the dam faces during construction, the result being that at no place on the dam is variation from true line greater than one inch. As a result of careful proportioning of the aggregates and handling of the concrete, the exterior surfaces are notably free from irregularities and voids.

When concreting was started, a 4 x 6-ft. opening was left in the lowest portion of the dam. This was sufficient to pass the stream flow during construction. After the work was entirely completed and closure was desired a 4 x 5-ft. gate valve which the contractor happened to have on hand was fitted to a frame around the opening on the upstream face and arranged to be operated by a 3-in. pipe, 150 ft. long, running to a hand wheel on top of the dam. The pipe was held in place by wooden guides fixed to the face of the dam. After the gate was closed, the opening through the dam was concreted from the downstream end. No attempt was made to salvage the gate valve used to effect closure.

Quinton, Code and Hill, Los Angeles, were consulting engineers. The contract was awarded to Bent Bros. and W. A. Kraner, having supervision of the work. C. W. Hamilton and M. H. Slocum were resident superintendents.

Water and Moist Air for Absorption Tests

Exposure to moist air has been found just as severe a test as immersion in water, in testing the absorption of moisture by wood through varnish and other coatings. In tests made recently at the Forest Products Laboratory, birch panels with various coatings were tested by exposure to moist air (95 to 100% humidity) and water, respectively, for periods of 17 days. The weight gained from the moist air exposure was practically identical with that gained in the water immersion; for example, a coating consisting of a filler plus three brush coats of spar varnish allowed 12.60 grams of water to pass per square foot of surface in water exposure and 12.25 grams in moist air exposure.

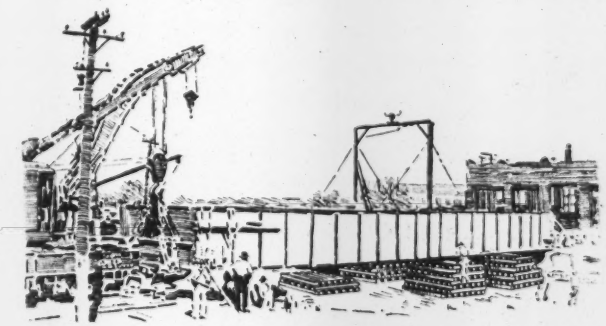
Lifting a Turntable Out of Its Pit Without Jacking

By G. T. Kuntz
Assistant Engineer, Union Pacific R.R., Junction City, Kansas

A ONE hundred-ton turntable, 92 ft. long, for the new round house of the Union Pacific R.R. at Junction City, Kan., was moved Sept. 12, 1919, from an old to the new location, 1,600 ft., between 10 a.m. and 8 p.m. Speed in raising the turntable out of the old pit, was obtained by lifting one end with a 100-ton wrecking crane and rocking the other end over two cribs of ties.

Cribbing at the new site was completed several days before moving the old turntable. Also all ties and timbers necessary had been brought to the site. The motor and cab were removed for overhauling while the moving operation was taking place.

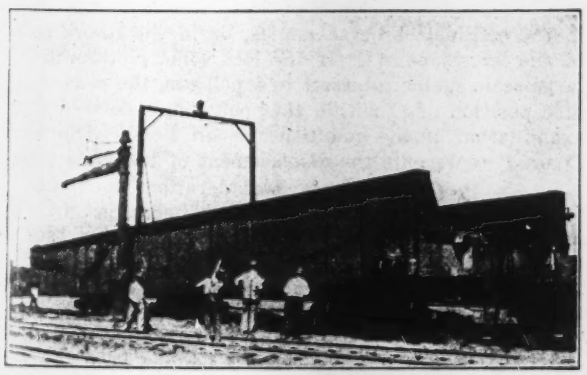
The table was lifted up at one end by the wrecking



WRECKER RAISING TURNTABLE BY ROCKING OVER CRIBS

crane and when the first lift was made, the middle crib shown in the sketch, was built up as high as possible. The wrecker end was then let down and the end crib was built as high as possible. The wrecker end was again lifted and additional cribbing put on the middle crib. The table was rocked in this manner until the cribbing was high enough to permit the placing of car trucks underneath. This method of handling was found much quicker than using jacks on the end opposite the wrecker.

At the same time that the lifting was in progress, cribbing for the tracks (upon which the trucks to carry the table were to run) was put under the turntable. On this cribbing stringers were laid for the rails, the lifting cribs were placed so as to provide clearance for three 4-wheel railroad trucks on which the table was moved, but the third truck was not required. The trucks were fitted with heavy oak bolsters attached in such a manner as to allow the bolster to turn freely. As soon as the cribs were built up to clear the height of the trucks, the trucks were pushed under the table and the full weight was transferred to them. An engine then hauled the table to its new location, through several switches and around two sharp curves, but no difficulties were encountered. The table was lowered into its new position by the same method used to raise it.



TURNTABLE MOVED 1,600 FEET ON TRUCKS

As soon as the table had been taken out of the old pit, the center casting was removed by a long boom derrick and carried over to its new location, at the same time that the table was being moved by the locomotive. To allow the center casting to be placed quickly, the cribbing at the new site extended to within 4 ft. of each side of the center, and the gap was spanned by three 18 x 16-in. stringers placed under each rail.

Technical Control of Filters in Ohio

OHIO has fifty-one filter plants with a total daily capacity of 502,000,000 gal. Twenty-one are under constant supervision of a technical superintendent, twenty-two have intermittent technical supervision and eight have no technical supervision or analytical control. The State Board of Health, according to W. H. Dittoe, chief engineer, in a paper before the American Public Health Association, received reports from 47 of the plants including four of the last class. The eight plants which receive no technical supervision vary in daily capacity from 100,000 to 800,000 gal. Of the nine disinfection plants, eight are under technical supervision with analytical work to check efficiences.

The experience of the Department in connection with the control of operation of water purification plants has led to the adoption of certain guiding principles which are as follows:

1. Every filtration or disinfection plant should have some degree of technical supervision, and filter plants having capacities of 1,000,000 gal. per day or more should be under daily technical supervision. The superintendent of filtration, whether employed constantly or intermittently, should be given full authority over the plant and other plant employees. As the problem is principally plant operation and maintenance, the employment of an analyst to examine samples and act in a merely advisory capacity does not provide efficient supervision.

2. The superintendent of filtration should be qualified by training in water supply engineering, chemistry and bacteriology, and, when employed for the larger plants, should have had experince in the operation of a smaller one. In rare instances it is possible for a man to become qualified by experience without fundamental technical training.

3. In passing upon the operating results of a water purification plant the efficiency of each individual process should be considered independent of the next succeeding process. Coagulation must be efficient to prevent excessive load on filters. When daily technical supervision is not provided, a factor of safety must be furnished by using constantly a quantity of coagulant as specified by the department in excess of that which would otherwise be required. The rate of operation of gravity rapid sand filters should not exceed 125,000,000 gal. per acre daily, and if this rate is exceeded filter efficiency suffers. Disinfection should be applied to filter effluents and must be a true factor of safety.

4. The final effluent of the purification plant must show negative presumptive tests for B. coli in at least 80 per cent of all samples collected throughout the month. If the construction of the purification plant will permit, this standard is applied to effluent of filters before disinfection, in which case disinfection becomes a true factor of safety.

Triangulation Simplified By Army Co-ordinate System

By H. A. Foster
Former Second Lieutenant, 29th Engineers, U. S. Army

A DESCRIPTION of the U. S. Army Engineers' adaptation of French military methods of applying to surveying and mapping a system of rectangular co-ordinates based on the Lambert conformal conic projection was given in a previous article in *Engineering News-Record*, May 13, 1920, p. 962. An explanation will be given here of four methods of computation which were utilized in applying the system to triangulation, and which greatly simplify the latter operation. They are the *intersection*, the *three-point*, the *resection* and the *approximate orientation* methods.

First, to derive necessary equations for finding Y-azimuths and distances, consider two points, *A* and *B* (Fig. 1), joined by the line *AB*. The co-ordinates of *A* are x_a, y_a; and those of *B* are x_b, y_b. Now the Y-azimuth of the line *AB* is its inclination to the Y-line through *A*, measured clockwise around the circle from the north. It is generally called V_{ab}. It can be seen that the Y-azimuth of the line *BA*, or V_{ba}, is equal to $180° + V_{ab}$.

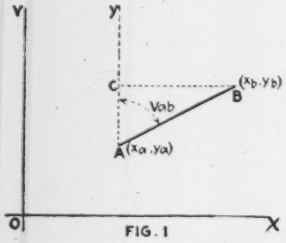


FIG. 1

Let *Ay* be the Y-line through *A*. In the right triangle *ABC*,

tan *CAB* = *BC*/*AC* = $(x_a - x_b)/(y_a - y_b)$, or

$$\tan v_{ab} = \frac{(x_a - x_b)}{(y_a - y_b)} \qquad (1)$$

When the differences $(x_a - x_b)$, $(y_a - y_b)$ are taken in magnitude without regard to sign, the angle *v* thus computed is the small angle by which line *AB* is inclined to the Y-line. The Y-azimuth is easily derived from angle *v*, if the respective positions of *A* and *B* are noted.

In Fig. 1, let *D* equal the distance from *A* to *B*. Then,

$$D = \frac{x_a - x_b}{\sin v} = \frac{y_a - y_b}{\cos v} \qquad (2)$$

Suppose the instrument has been set up at a known point—a point whose co-ordinates are already known—and a set of readings has been taken on several other points, one of which is also known. The Y-azimuth from the instrument to this other known point can then be computed by means of eq. (1). Also the Y-azimuths to all of the unknown points may be determined by means of the angles observed between the known point and the unknown points.

In triangulation the simplest way to locate a new point is to take sights on it from several known points—the *intersection method* of location. The sights if plotted to a large scale would appear as a group of intersecting lines which form a small polygon. The most probable position of the new point will then be somewhere within this polygon of error.

The principal characteristic of the method of computation to be described here is the use of an approximate point. Instead of taking the angles as observed, and making a direct analytical solution of the problem, we make a preliminary graphical solution, by actually plotting the known points and observed angles to a small scale, the intersection of the several plotted sights locating the unknown point. The co-ordinates of this point are then scaled off as accurately as the scale of the plotting will permit. These co-ordinates define a certain point on the map, which is near the true position of the unknown point, and hence is called the "approximate point." The next step is to compute the corrections to be applied to the co-ordinates of the approximate point in order to obtain the true co-ordinates of the desired point. Let us call *A* (see Fig. 2) the approximate point and *O* the desired point and let *M* be one of the known points from which *O* has been sighted. First compute the Y-azimuth of the *observed* direction, *MO*, by means of the reading on *O* as described above, which is V_o, or the angle *yMO*. The Y-azimuth from *M* to the approximate point *A* may be calculated by means of eq. (1), since the co-ordinates of both *M* and *A* are *known*. This gives V_a, which is the angle *yMA*.

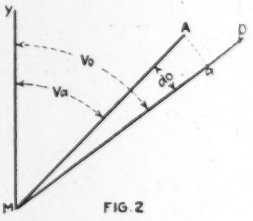


FIG. 2

Now from *A* drop a perpendicular, *Aa*, to the line *MO*. The angle *AMa*, or *do*, is equal to $V_o - V_a$. Then we have, in the triangle *AMa*, $Aa = MA \cdot \sin do$. The distance *MA*, or *D*, may be calculated from the co-ordinates of *M* and *A*, eq. (2). If *do* is less than three degrees, we can replace sin do by *do* (in minutes) x sin 1′, or dó sin 1′.

Hence, letting *Aa* = *q*,

$$q = D \text{ dó sin } 1'. \qquad (3)$$

Now let us draw a sketch showing the area in the vicinity of *A* and *O*, to as large a scale as possible—such as 1:100. By means of the distance *q*, and the Y-azimuth V_o, we can plot the line which represents the sight from *M* to *O*. The true position of *O* will then be somewhere on this line, which is therefore called the "locus" for the observation from *M*. Such a locus can be drawn for each intersection observation taken on the desired point from the other known points. The common intersection of these loci gives the desired point *O*. From the co-ordinates of *A* the co-ordinates of *O* may be determined by scaling from the large-scale sketch the differences in their *X* and *Y* co-ordinates.

The intersections of the above loci, however, usually give a triangle or polygon of error, due to discrepancies in the original observed angles, or in the co-ordinates of the known points. If the loci when plotted on the large-scale sketch intersect in a polygon, the most probable position of *O* within this polygon is derived from examination of the quantities *D* sin 1′ dó. The term *D* sin 1′ represents the displacement of the locus under consideration when the Y-azimuth changes by 1′. Hence the relative "sensitivities" of the loci may be considered as being proportional to the distances from the known points to the desired point. Suppose, for instance, in Fig. 3, that

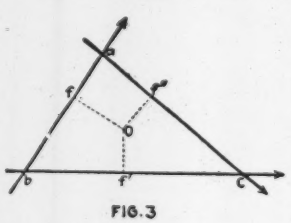


FIG. 3

the triangle of error, *abc*, is obtained. The problem is to locate *O* in such a manner that the perpendicular distances to the loci will be respectively proportional to the sensitivities of the loci; or so that

$$of/D = of'/D' = of''/D'',$$

where *D*, *D'* and *D''* are distances from *A* to the known points, from which observations were taken. The graphical location of *O* may be made by replacing the triangle of error by a smaller similar triangle within, its sides distant from the original loci by amounts respectively proportional to *D*, *D'* and *D''*.

Fig. 4 shows such a sketch. *A* is the approximate point, and *O* is the true position of the new point.

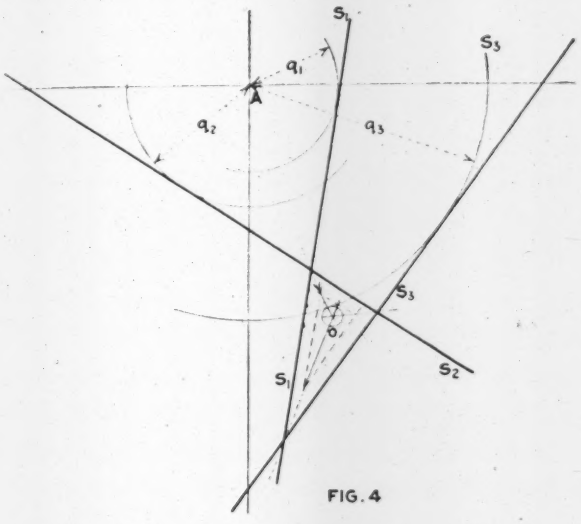


FIG. 4

Sights have been taken upon *O* from the known points S_1, S_2 and S_3—(which are not shown on the sketch). The corresponding loci are plotted by means of the distances q_1, q_2 and q_3, and the respective Y-azimuths of the three loci. The correct position of the point *O* is found in the triangle of error as described above. The differences between the co-ordinates of *A* and *O*—i.e., *dx* and *dy*—are scaled from the drawing, and the co-ordinates of *O* are computed from those of *A*. Thus, in the figure,

$x_a = 29395.0$	$y_a = 444417.0$
$dx = +1.0$	$dy = -2.7$
$x_o = 29396.0$	$y_o = 444414.3$

If the instrument has been set up at an unknown point, and observations are taken on three or more known points, the new point is located by the *three-point* method. Thus, in Fig. 5 *M* and *N* are two known points which have been sighted from *O*, and α is the observed angle. Then *O* will lie somewhere on the circumference of the circle *MON*, whose radius is determined by the fact that the chord *MN* must subtend the angle α. The arc of this circle in the vicinity of the correct position of *O* is a locus for the point *O*, determined by the angle α. The intersection of several of these loci will give the correct position of the unknown point.

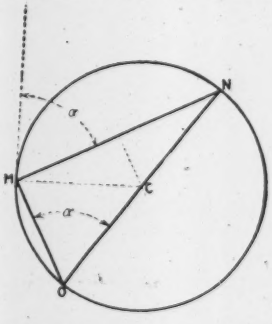


FIG. 5

In this method, as in the intersection problem, we make use of an "approximate point," *A*, in order to determine the true co-ordinates of the desired point, *O*. We now consider the graphical methods of determining the approximate point.

1st Method—Two circles can be plotted, one being the locus of all points which will subtend the observed angle *MON*, and the other the locus of all points which will subtend the observed angle *NOP*. Each circle may be drawn as follows: at *M*, lay off the observed angle *MON*, as the angle α; to the line thus determined draw a perpendicular at *M*, intersecting the perpendicular bisector of *MN* at *C*; construct a circle with radius *MC*, and center *C*. Any point on this circle will subtend the observed angle *MON* between stations *M* and *N*. Similarly, draw another circle, using stations *N* and *P* or *M* and *P*. The point desired, that is, the approximate point *A*, lies at the intersection of the two circles.

2nd Method—Suppose α to be the measured angle between *M* and *N*, and β to be the measured angle between *N* and *P*; *M*, *N* and *P* are the known points. As in Fig. 6, draw *MS* perpendicular to *MN*, and *PR* perpendicular to *NP*. Draw *NS* making the angle *MNS* equal to $(90° - \alpha)$. Draw *NR* making angle *PNR* equal to $(90° - \beta)$. These two lines interesct *MS* and *PR* in *S* and *R*. Draw *RS*. Draw *NA*, from *N* perpendicular to *RS*. Then *A* represents the approximate point. *Proof*—Suppose *m*, *n* and *p*, Fig. 7, to be plotted from known points, and suppose *a*, the approximate point, to be already located. Suppose circles *mna* and *npa* to be drawn. Draw *ms* perpendicular to *mn*, cutting the circle at *s*, and draw *pr* perpendicular to *np* cutting the other circle at *r*. Draw *as* and *ar*. Since *smn* and *npr* are right angles, *ns* and *nr* are diameters. Hence angles *nas* and *nar* are right angles, and *sar* is a straight line.

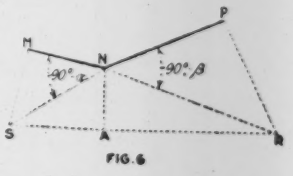


FIG. 6

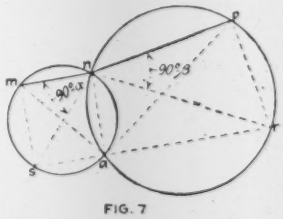


FIG. 7

Now angle *man* = α and *nap* = β; therefore *mas* = $90° - \alpha$ and *par* = $90° - \beta$.

But angle *mas* = angle *mns* and *par* = *pnr*. Hence, *mns* = $(90° - \alpha)$ and *pnr* = $(90° - \beta)$. Therefore the construction described for locating point *a* is geometrically correct.

Determination of Point by Three-Point Method.—Sights have been taken from *O*, the desired point, to known stations *M*, *N*, *P*, *etc.* An approximate point is first found graphically and definite co-ordinates x_a and y_a assumed for the point *A*. Next the observations are considered in pairs, as for instance, the two known points *M* and *N*. The problem is to draw a locus containing *O* by means of a distance computed from *A*. This locus is drawn on a large-scale figure. The same operation is performed with the observations on *N* and *P*, giving another locus which intersects the first one in the desired point. Then the values of *dx* and *dy*, or the amounts to be added to x_a and y_a to obtain the co-ordinates of *O*, are scaled from this large-scale drawing. In

case a check is made, or several three-point problems observed, a point O is chosen from the triangle or polygon of error as explained later.

Now in Fig. 8, a, m and n represent the assumed point A and the known points M and N, the co-ordinates of which are known. Suppose a circle described through m, n and a. (This circle is in this figure only for demonstration. In the large-scale sketch only the point A and the loci are plotted, as of course the points M and N would be off the sketch). Through a, draw a tangent at. Suppose o to be the location of the desired point. The problem now is to compute the displacement ai of the circle, so that the tangent or the circle—they coincide in the large-scale sketch—will pass through o. Also, as points a and o are close together, tangent $t'o$ to circle mno may be considered as parallel to at.

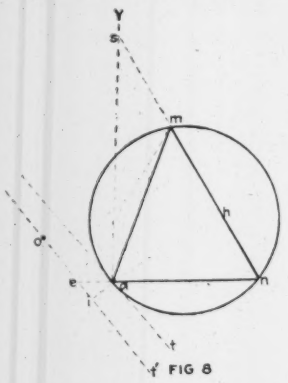


FIG 8

Draw ah perpendicular to mn, and ai perpendicular to at and ot'. Prolong na to meet ot' in e, and draw em. Now, in the triangles amh and aei, the angle aei (= angle nat) is measured by arc $na/2$ as is angle amh, as well. Also the triangles are right triangles and therefore are similar. Hence,

$$ai/ah = ae/am \quad \text{or} \quad ai = ah \times ae/am$$

or q, the displacement desired, equals $ah \times ae/am$.

Now consider the triangle aem;

$$am/\sin aem = ae/\sin ema. \tag{4}$$

But we have assumed that the circle mon coincides with the tangent, ot', in the vicinity of o, when the sketch is to a large scale. Therefore the angle men is equal to angle mon, being measured by one-half the same arc in the same circle.

Angle men = angle mon = $R_n - R_m$, where R_m and R_n are the readings of the instrument at O, on M and N respectively.

Call $R_n - R_m$ the observed angle, O. Then, angle $men = O$. Hence $\sin aem = \sin O$; and by eq. (4),

$$am/\sin O = ae/\sin ema \tag{5}$$

Now, angle man = angle ema + angle mea,
or angle ema = angle man − angle mea
= angle $man - O$
= $(Y_{an} - Y_{am}) - O$
= $V_{an} - V_{am}) - O$

V_{an} and V_{am}, the Y-azimuths from A to N and M respectively, are easily computed since the co-ordinates of A, N and M are known, from the formula of eq. (1).

Call the angle ema, do. Then, $do = (V_{an} - V_{am}) - O$.

Now, $q = ah \times ae/am$ (from above)
or calling $ah = h$, $q = h \times ae/am$.
But from eq. (5) above, $ae/am = \sin ema/\sin O$.
Hence, $q = h \sin ema/\sin O = h \sin do/\sin O$.
or, when do is small,

$$q = \frac{h}{\sin O} \sin 1' \, do \text{ (in minutes)}. \tag{6}$$

Next, work out another formula for h. In triangle amn, $am/\sin mna = mn/\sin man$.
Call $am = d$; $an = d'$; $mn = D$.
Then, $d \sin mna = D/\sin man$,
or $d/D = \sin mna/\sin man$. Multiply by d'.
Then, $dd'/D = d' \sin mna/\sin man$,
or $dd'/D = h/\sin man$. (7)

Now, from above, angle man = angle $ema + O$
$= do + O$.

Hence, $\sin man = \sin do \cos O + \cos do \sin O$.
But, when do is very small, $\sin do$ = zero; and $\cos do = 1$ (approximately).
Hence, $\sin man = \sin O$.
Substituting this in eq. (7) above gives

$$\frac{dd'}{D} = \frac{h}{\sin O}. \tag{8}$$

Substituting Eq. (8) in Eq. (6) gives

$$q = \frac{dd'}{D} \sin 1' \, do'. \tag{9}$$

This formula gives the required value of the displacement of the circle; and since the circle and its tangent coincide near O for the large-scale sketch, the locus containing the required point is a line whose distance from A is given by the above formula for q. Values d, d' and D are easily found from the co-ordinates of M, N and A; and do, equal to $(V_{an} - V_{am}) - O$, is easily found since O is measured and V_{an} and V_{am} can be found from the co-ordinates of M, N and A.

The distance from A to the line containing O is then computed. It remains to find its direction. It should be remembered that, since o and a are close together, we may consider at and ot' parallel.

Angle Yat = $Yan + nat = V_{an} + amn$.

Produce nm to meet aY in s.
Then, $amn = asm + sam = asm + V_{am}$.

Hence, Angle $Yat = V_{an} + V_{am}$ + angle asm
$= V_{an} + V_{am} + (180° - V_{mn})$
$= V_{an} + V_{am} - V_{mn}$

Calling angle Yat, the Y-azimuth of the tangent at, V_s, we have

$$V_s = V_{am} + V_{an} - V_{mn} \tag{10}$$

The three Y-azimuths V_{am}, V_{an} and V_{mn} may easily be computed from the co-ordinates of M, N and A.

Remarks—(1) When the point O is determined by the intersection of several of these lines, the point is finally chosen from the triangle or polygon of error. This is done remembering that since

$$q = \frac{dd'}{D} \sin 1' do',$$

the sensitivity of any of these lines is

$$\frac{dd'}{D} \sin 1',$$

which is the change in q for a change of 1′ in do. Obviously, the sensitivities of loci are directly proportional to their respective values for dd'/D.

(2) To check the computations, if there are three known points only, three loci may be obtained by choosing three of the different pairs of known points. For instance, if the known points are M, N and P, by taking the angle on M and N one locus is obtained; on M and P another; on N and P a third. If the work is correct these three lines should intersect in a point, for the three points M, N and P are only sufficient to locate the desired point without check.

(3) The position of the locus relative to the approximate point (that is, the side of the circle of radius q on which the locus is plotted) must be determined by examination of the plotted positions of the known points. Determine by inspection the location of the center of the circle through the two known points, M and N, and the approximate point A. Let O be the angle observed at the true point, between M and N; and let C be the computed angle at A between M and N ($C = V_{an} - V_{am}$).

Then if C is greater than O, the locus will lie on the side of A away from the center. If C is smaller than O, the locus will lie on the side of A toward the center.

The Resection Method

The resection method is a combination of the intersection and three-point problems. Sights have been taken to known points from the desired point O, which has also been sighted from other known points. The location of the approximate point is graphically obtained. The "intersection" loci and the "three-point" loci are determined as explained above and are plotted on the same sketch. The correct position of the desired point is chosen in the polygon of error, after considering the sensitivities of the several loci.

Fig. 9 illustrates the use of the resection method. M, N, P and Q are known points, and O is the desired point. M and N have been sighted from O, and the circle through M, N and O is a locus for the desired point. O has also been sighted from P and Q. Hence we have two intersection loci and one three-point locus, and the point is located with one check. The solution of this particular example by ordinary methods would be rather inconvenient, but by this method, it is very simple.

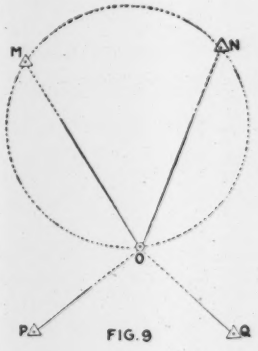


FIG. 9

Eccentric Stations—In the location of a point by resection, it may happen that the instrument cannot be set up over the desired point—the "signal"—but must be moved to an eccentric point nearby, from which the observations are made. However, sights to this station from other known points are made on the *signal* and not on the eccentric point. In performing the computation for such a case, we first determine an "approximate point" for the *signal* by plotting the intersection observations on the small-scale diagram. Let the true position of the signal be C, and the approximate point for the signal be A_1. Also let S be the true position of the eccentric point, or the position of the instrument. Having determined the co-ordinates of the approximate point A_1 from the plotting board, it is necessary to compute the co-ordinates of a corresponding approximate point for S, the eccentric station. Call this approximate point A. These two points A and A_1 are only approximate points for S and C. But the *differences* between the co-ordinates of A and A_1 are correct, and are the actual differences between those of S and C.

In Fig. 10, S is the eccentric station where the resection angle is taken. C is the signal observed upon by intersection. M is a known point sighted from S.

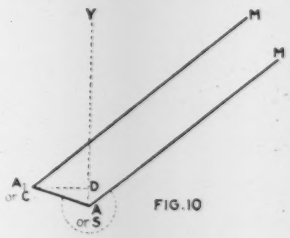


FIG. 10

If SC be small, V_{sm} may be considered equal to V_{cm}. V_{cm} may be computed from known co-ordinates of M and A_1. Therefore V_{sm} is known. Formulas will be deduced for the difference betwen the co-ordinates of S and C, or A_1 and A. Suppose the reading on C to be r_c and on M to be r, and let L = ecc. distance = SC.

$$V_{sc} = V_{sm} - (r - r_c).$$
$$dx = CD = SC \sin CSD = L \sin V_{sc}$$
$$dy = DS = SC \cos CSD = L \cos V_{sc}.$$

Then if we are computing the co-ordinates of S from those of C,

$$\left.\begin{aligned} x_s &= x_c + dx \\ y_s &= y_c + dy \end{aligned}\right\} \text{ or } \left\{\begin{aligned} x_a &= x_{a_1} + dx \\ y_a &= y_{a_1} + dy \end{aligned}\right.$$

Having the co-ordinates for the two approximate points, A_1 and A, the resection computation is then carried through as follows:

N and P being two known points sighted from the eccentric point S, we compute a locus containing S from the angle observed between N and P, by the ordinary three-point method of computation, using approximate point A. If the signal, C, has been sighted from the known point M, another locus containing S is determined by computing the displacement q, using A_1 as the approximate point, and then drawing the locus as if it had been computed for the approximate point A. The intersection of these two loci gives the location of S on the sketch. Then dx and dy, scaled off and added to the co-ordinates of A, give x_s and y_s, the desired co-ordinates of S.

To show why the procedure described above is used the following explanation is given. (See Fig. 11.) The approximate points A and A_1 are plotted in their correct relative positions.

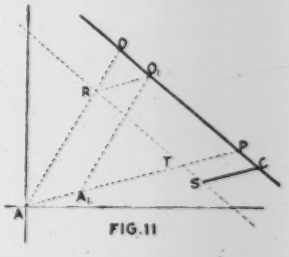


FIG. 11

Using A_1 as the approximate point for C, A_1O_1 is computed as the displacement to the *intersection* locus, for the angle observed at M, say. OP is this locus, and the correct position of C is somewhere on it, as shown in the figure. Draw O_1R parallel to A_1A, and drop AO perpendicular to OC, cutting O_1R at R. Then AA_1O_1R is a parallelogram, and O_1R is equal to A_1A.

Now draw RS parallel to OC, and draw CS parallel to O_1R. Then CS is parallel and equal to A_1A. And therefore S is the correct position of the eccentric point, if C is the correct position of the signal. In other words, RS is a locus containing S.

But $AR = A_1O_1$. Hence the *Locus RS containing S* would have been obtained if we had plotted from A, as the approximate point, the displacement A_1O_1. Then on a large-scale sketch, with A plotted and A_1 not plotted, we can draw loci as follows containing S: Any three-point locus, computed as usual with A as the

approximate point. Any intersection locus, with observation made on C, the displacement having been computed from A, but plotted from A on this sketch.

The desired point S should be chosen from the triangle or polygon of error, by weighting the loci by the ordinary methods for intersection and three-point problems.

This method of treating the eccentric station computation is very useful, for it eliminates the necessity of reducing the observed angles to what they would have been if the measurements had been made at the center, as is generally done in this country.

Suppose angles are measured by the three-point method at point O, with observations on M, N and P. (Fig. 12.) Obtain a point as near O as possible, by one of the graphical methods already given for finding the approximate point in the three-point problem. Call this point A. With its coördinates of one of the known points, say M, we may compute the Y-azimuth, V_{ma} or V_{am}.

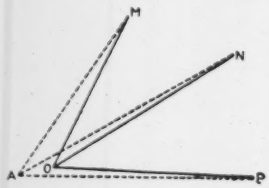


FIG 12

Using this value of V_{am} as an approximate value, V'_{om}, for the Y-azimuth from O to M, compute from the observed angles approximate Y-azimuths to N and P, giving V'_{on} and V'_{op}. It is to be remembered that if Y-azimuths had been *computed* from A to M, N and P, they would not differ by these observed angles. Also notice that each of the three approximate Y-azimuths found as stated above differs from its true value by a constant amount, namely the difference between the Y-azimuths V_{am} and V_{om}, the latter being unknown. From these, we know the azimuths in the opposite directions over the lines. That is, we have *approximate values* V'_{mo}, V'_{no} *and* V'_{po}, the first being V_{ma} and the others being in error by the difference between V_{ma} and the true value of V_{mo}, which is unknown. With these three approximate values V'_{mo}, V'_{no} *and* V'_{po}, compute three loci, using the approximate point A and following the intersection method. Note that, since the approximate value of V_{mo} is equal to V_{ma}, the displacement, q, for the first locus will be zero.

These three intersection loci will give a triangle of error for O on the large-scale sketch. However, the two three-point angles furnish no check; and the triangle of error results *solely* on account of the difference between V_{ma}, approximately V_{mo}, and the true value of V_{mo}, or the error in the assumed orientation. Changing V_{ma} by a certain value simply amounts to changing the approximate Y-azimuths V'_{mo}, V'_{no} and V'_{po} by a constant amount. Hence, from the triangle of error, the point O is determined by moving each locus by an amount proportional to its sensitivity (or proportional to D), all being moved in directions corresponding to changes in the approximate values V'_{mo}, V'_{no} and V'_{po} in the same direction, the movement being such as to reduce the triangle of error to a single point. This then will be the true point O determined from the two angles without check.

This method corresponds exactly to the three-point location as determined with a plane-table. The use of an approximate Y-azimuth, V'_{mo}, corresponds to the approximate orientation of the plane-table, and the selection of the final point in the triangle of error is performed in the same manner as on the plane-table.

Now consider how to use this method in connection with ordinary intersection observations; that is, in resection. Let Fig. 13 represent a portion of the large scale adjustment sketch. BM is the locus determined from M, and BN is the locus determined from N by the approximate orientation method described above. Now the sensitivity of any intersection locus, proportional always to the distance from the known point to the approximate point, is likewise proportional to the distance the locus would be moved if the azimuth of the observed line were changed by a certain amount. Suppose we change our original orientation by a certain arbitrary amount, thereby changing V'_{mo}, V'_{no} and V'_{po} by the same amount. Then locus BM is transposed parallel to itself to some position like CD, and BN to CE, the distances CK and CH by which the two loci are transposed being proportional, respectively, to the relative sensitivities, or to D_{am} and D_{an}. Draw BC.

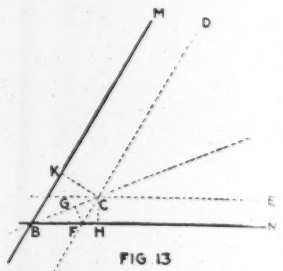


FIG 13

Now, in changing the original orientation, the Y-azimuths of both of the loci have been changed by the same amount, and hence, the angle between them has not been changed. Therefore BC is the locus of all the points at which the same angle would be observed between the two known points M and N. In other words, BC is the three-point locus for the angle observed at O between M and N. The sensitivity of this three-point locus is found as follows:

Let F be the point at which CD intersects BN. Draw FG perpendicular to BC. Now F represents the point to which B would be moved if the observed Y-azimuth for the intersection locus BM were changed without changing the Y-azimuth for BN. This amounts to changing the value of the original angle observed between the two known points M and N by the same amount by which the observed Y-azimuth for the locus, BM, was changed. Therefore F is a point through which the three-point locus, BC, would pass if the observed angle were changed by the given amount, and FG represents the distance by which the three-point locus would be transposed. Therefore FG represents the sensitivity of the three-point locus, and is measured on the same scale as CK and CH.

For example, suppose $D_{ma} = 7{,}000$, and $D_{na} = 6{,}000$. Suppose we make KC equal to some arbitrary distance like 14 mm., which is convenient. Then HC must be made equal to 12 mm. in order that BM and BN may be transposed by distances proportional to their sensitivities. These transpositions would result by changing V'_{mo} and V'_{no} by the same amount, or in other words by changing the approximate orientation by a certain amount, this amount being something which we neither know nor wish to know. Then if we find FG equal to 8 mm., we know that the relative sensitivity of the three-point locus BC, is equal to 4,000. In other words, the relative sensitivity of the three-point locus is equal to

$$\frac{D_{na}}{CH} \times GF, \text{ or to } \frac{D_{ma}}{CK} \times GF.$$

The three-point locus can now be used in connection with any intersection locus. A locus determined by an

tersection observation from *P*, for instance, would be plotted, and its relative sensitivity would be taken as *P-Q*; and the three-point locus would be combined with the intersection locus, as in the resection method.

In Fig. 14 is shown an example of the plotting for this method. In this example, the known points *M*, *N*, *P* and *Q* were sighted from the unknown point. An approximate Y-azimuth for *OQ* was computed from the co-ordinates of the approximate point *A*, and the several loci *MM*, *NN*, *PP* and *QQ* were determined as described above. Then these loci were transposed to their dotted positions. The displacement of the locus *MM*, for example, was proportional to the distance *MA*. Then the corresponding *three-point* loci, shown in heavy lines were drawn. These all intersected in a common point, *O*; and there was no polygon or error. But if there had been a polygon of error, the *three-point* loci would have, themselves, been transported by amounts proportional to their sensitivities. For example, the sensitivity of the locus *M-Q* is proportional to the distance *ab*. In this example, no direct intersection loci are given. But if there had been intersection observations, their loci would have been computed by the regular method, using the approximate point *A*. Then these loci would have been combined with the three-point loci, such as *M-P* and *M-Q*.

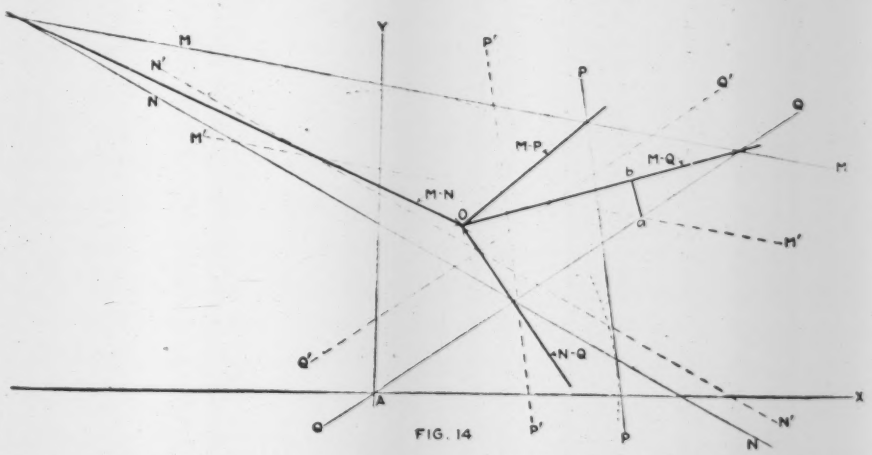


FIG. 14

In the foregoing discussion, the simple intersection and three-point methods are the easiest to understand and to use. The resection method is merely a combination of these two, with certain modifications in the case of an eccentric station. The approximate orientation method is the most difficult to understand—the sketch which must be plotted is more complicated than in the simple three-point method—but the actual amount of computation involved is considerably less, and after a little practice it would probably be considered the most desirable one to use.

The methods described in this article were developed chiefly by officers in the French army. The explanation of the methods as given herein is based on lectures given to the computing division of the 29th Engineers, U. S. Army, by First Lieut. E. F. Church, formerly of the U. S. Coast and Geodetic Survey.

TABLE I. REPRESENTATIVE TRAVERSE CIRCUITS ON THE SURVEY AT FLINT, MICH.

Distance Around Circuit, Feet	Error in Latitude	Error in Departure	Error of Closure
31,717.83	1.44	2.64	1 : 10,550
23,682.10	0.93	0.40	1 : 23,400
44,695.95	0.34	0.95	1 : 35,025
29,104.60	0.45	1.48	1 : 18,825
11,837.20	0.51	0.01	1 : 23,175
27,478.24	0.85	0.07	1 : 32,225
36,211.05	0.57	1.72	1 : 19,975
17,260.00	0.14	0.51	1 : 32,625
16,110.70	0.18	0.62	1 : 24,950
21,915.35	0.88	0.59	1 : 20,675
Average			1 : 24,150

TABLE II. ACCURACY OF TOPOGRAPHIC SURVEYS

(Comparative study based upon test profiles)

	Dayton	Jackson	Flint
Length of test profile	3,162 ft.	3,150 ft.	6,423 ft.
Number of test points	50	52	130
Extreme relief	51 ft.	38 ft.	30 ft.
Total plus areas	591 sq.ft.	1,048 sq.ft.	896 sq.ft.
Total minus areas	1,002 sq.ft.	628 sq.ft.	792 sq.ft.
Aver. uncompensated area	0.134 sq.ft.	0.188 sq.ft.	0.016 sq.ft.
Average error of each test point	0.55 ft.	0.53 ft.	0.26 ft.
Test points that disagree with contours: By more than 0.5 ft.	35%	37%	22%
By more than 1.0 ft.	15%	11%	0.03%
By more than 1.5 ft.	7%	4%	None

Note:—Scale of map in each of the above surveys is 1 in 2,400, with a contour frequency of one foot. The results for the Dayton and Jackson surveys are obtained from a number of tests. Only one test profile on the Flint survey was available when this table was prepared.

A Course in How To Use the Mind

There is one particular subject which I believe should be taught to all students of all faculties and it is a question upon which I am rapidly becoming somewhat of a crank. I refer to the importance of teaching the students the best methods of intellectual work. It seems illogical to me to take the trouble to initiate the students in the principles of the different sciences with an abundant use of language and a great display of apparatus, to compel them afterward to pass severe examinations on these various sciences, and, yet, not to consider it worth while to instruct them in the art of cerebral work.

Apparently all of us seem to take for granted that the students know, by intuition, the best methods of study, although it has been demonstrated that they invariably adopt the worst ones because they are less painful and do not make the same demands upon their powers of attention or concentration.

Students unconsciously drift into bad intellectual habits, and only realize their mistakes when it is very difficult to adopt new methods. "You cannot teach an old dog new tricks" is an old saying and William James considers that men fall into the "old dog" class at twenty-five. This eminent psychologist declares that fe wmen change their habits of thought and action to any marked extent after they are passed the middle twenties. It is easy to surmise that Professor James either married in his early twenties or died a bachelor. Those of us who married after we passed thirty can vouch for the fact that habits can be modified after that age, but we will probably also admit that our road to perfection would have been made easier if the way had been pointed out to us when we were in our early twenties.

Psychologists as a general rule also tell us that relatively few people acquire new habits of their own volition. Habits are for the most part inherited or imposed upon us by external authority, and it seems to me that in order to spare to the student this reversal of intellecual method long after his graduation, cerebral habits of the right kind should be imposed upon him, at the very beginning of his college career, through the institution of a course on "How to use the mind"—*Arthur Surveyer* in a discussion before the Engineering Institute of Canada.

Highway Inspection Methods Taught at Oregon Institution

Agricultural College and State Highway Commission Co-operate to Secure Competent Inspectors on Highway Construction

By S. H. Graf

Professor of Experimental Engineering, Oregon Agricultural College

For a number of years there has existed very close co-operation between the state highway department and state college of Oregon. One form of this co-operation has been the employment of students during the summer months as members of field parties and as inspectors on highway and bridge construction. This year the program under way is of considerable magnitude, totaling nearly twenty million dollars. Naturally, the greatest activity must take place during the summer, which is also the vacation period of the college, so that undergraduate students fit very nicely into the construction program of the highway department. In this way, these students may earn money and at the same time gain experience so that upon graduation, on account of their practical experience, they will be more valuable men.

During the past two seasons, many students have been used as inspectors, but since they have been without experience and in the case of lower classmen, without any instruction in highway engineering subjects, a preliminary training of several weeks has been required. This, of course, is expensive and during the rush season very inconvenient. In order to avoid or shorten this field training, the writer was asked by State Highway Engineer Herbert Nunn to design a course for students desiring summer work as inspectors. After consultation with Dr. E. W. Lazell and K. S. Hall, in charge of testing and inspection, the course outlined below was planned, and is being given to about forty students. It is a three-credit course, consisting of twelve lectures and twelve three-hour laboratory exercises. In addition to this, there are problems and assigned readings for home work. The state highway department supplies the students with copies of the specifications, manual of instructions to employees, report blanks, etc., and these are studied and discussed. In explanation of what in some sections of the country would be regarded as a peculiar limitation of the subject, it should be stated that at present only two principal types of pavements are used in Oregon, asphaltic concrete (both fine and coarse aggregate), and portland cement concrete (one course only).

The syllabus of the course follows:

Lectures

1. On types of pavements
   - a. Specifications
   - b. Asphaltic pavements: sheet, fine aggregate asphaltic concrete, coarse aggregate asphaltic concrete
   - c. Cement concrete pavements: One course, two courses.
2. Paving materials
   - a. Asphalt
   - b. Portland cement
   - c. Concrete sand
   - d. Mason sand
   - e. Muck sand—filler
   - f. Gravel—pebbles and crushed
   - g. Crushed stone.
3. Sampling methods
   - a. Asphalt
   - b. Portland cement
   - c. Sand
   - d. Rock—quarry and gravel
   - e. Paving mixtures.
4. Standard tests
   - a. Asphalt
   - b. Cement
   - c. Sand—concrete and paving
   - d. Gravel
   - e. Broken stone.
5. Proportioning of mixtures
   - a. Asphaltic
   - b. Concrete—standard and ideal. Often judged by looks on road
   - c. Calculation of mixtures (weight and volume)
   - d. Corrections for wet materials
   - e. Calculating yield of "pull."
6. Mixture tests
   - a. Asphaltic topping extraction
   - b. Specific gravity
   - c. Sawing sections
   - d. Photographing sections
   - e. Concrete—analysis—limitations of
   - f. Concrete sections.
7. Paving plants and equipment
   - a. Concrete mixers
   - b. Bituminous paving plants
   - c. Rollers
   - d. Trucks.
8. Mixture inspection
   - a. Rock—dryers, dryness
   - b. Asphalt—weight and temperature
   - c. Mixture—temperature
   - d. Cigar box samples
   - e. Check box weights
   - f. Scale tests—by standard weights—your own weight—or compare with each other
   - g. Concrete plants shut down for low temperature
   - h. Report forms.
9. Surface inspection
   - a. Subgrade — true, elevation, super-elevation templates
   - b. Materials—clean—dust-free
   - c. Cement—covered account of rain
   - d. Temperature of mix on road
   - e. Thickness. Yield. Calculations reviewed
   - f. Rolling
   - g. Surface appearance
   - h. Chopped samples
   - i. Report forms.
10. Characteristic defects
    - a. Cracks—too hot—too much sand—wet or yielding subgrade—too little asphalt
    - b. Flush coat—thin and even—water to help spreading
    - c. Squeegee hot—roll in while flush coat is hot
    - d. Concrete—cracks, pockets, roughness
    - e. Foreign matter—expansion joints flush—barricading, covering, and wetting.
11. Principles of inspection
    - a. Enforcement of specifications
    - b. Helpfulness—not antagonism
    - c. Catch mistakes—before they occur
    - d. Do not be autocratic
    - e. Plant and surface inspectors should co-operate with each other, with resident engineer, and with contractor.
12. Personal qualities requisite for success
    - a. Winning personality
    - b. Tactfulness
    - c. Firmness
    - d. Knowledge of specifications
    - e. Be sure you are right, then go ahead.

LABORATORY EXERCISES

1. Sieve analyses of sand, gravel, and broken stone.
2. Proportioning of mixture from representative supply of materials.
3. Mixing and molding representative types of pavements according to specifications.
4. Consistency tests of asphaltic materials.
5. Specific gravity tests on various materials.
6. Analysis of bituminous road surfacing.
7. Tests on portland cement.
8. Tests on concrete sands.
9. Tests on rock for pavements.
10. Mixing of, and compression tests on concrete cylinders
11. Visit to bituminous paving plant in vicinity.
12. Visit to concrete job in vicinity.

Chart for Discharge of Water Columns Supplying Locomotives

BY F. D. YEATON
Oak Park, Ill.

IN RAILWAY water supply work it is frequently necessary to determine the discharge from water columns and the accompanying chart has been found useful in the solution of such problems. This chart gives the discharge in gallons per minute through a 10-in. telescopic water column for various flow heads "H" and for both 10-in. and 12-in. cast iron pipes connecting with the tank at distances varying from 200 to 1,000 ft. The coefficients of friction have been taken from Bulletin 48 of the Universtiy of Illinois.

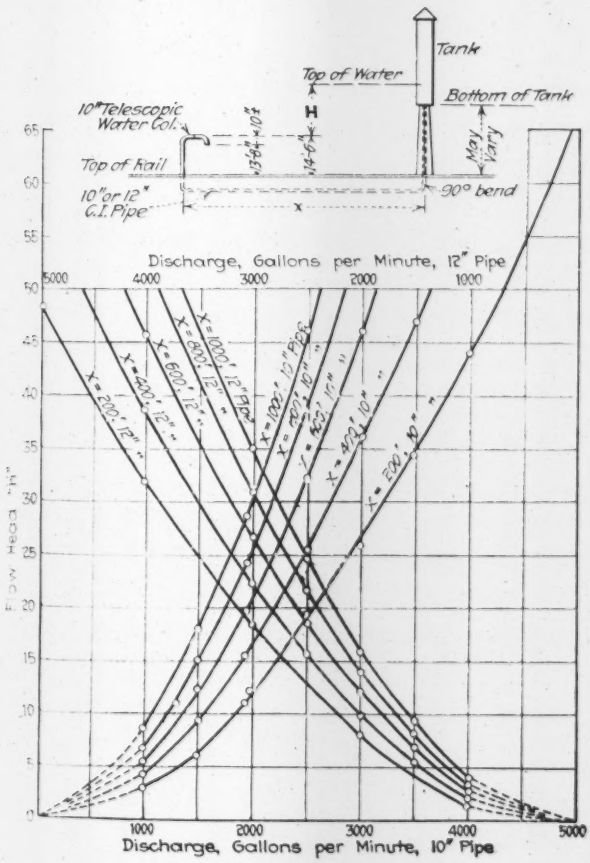


CHART SHOWS DISCHARGE OF RAILWAY WATER COLUMNS

The following problem illustrates the use of the chart and is typical of those encountered in practice: A water column is to be erected 600 ft. from a storage tank. It is desired to determine the minimum height of the tank to furnish 2,000 gal. per minute through a 10-in. column. The connecting line between the storage tank and column is 12 in. in diameter. Without the aid of the chart this problem would require several trials, but from the chart the flow head, H, necessary to give the required discharge at the water column, is read as 12 ft. The height of the tank can then be easily adjusted for the minimum flow. The formula for flow-head H is given below:

$$H = m\frac{v^2}{2g} + e\frac{v^2}{2g} + h_1 + n\frac{v^2}{2g} + \frac{v^2}{2g}$$

$m\frac{v^2}{2g}$ = entrance head

$e\frac{v^2}{2g}$ = loss in elbow or bend

$n\frac{v^2}{2g}$ = loss in water column

$\frac{v^2}{2g}$ = velocity head

If the height of the tank and water column are known, it is an easy matter with the aid of the chart to determine the maximum and minimum discharge from a water column located any distance from the storage tank.

Railways in China

OF 6,836 miles of railway in China in 1918, over 4,000 mi. of main and branch lines were owned and operated by the government, these comprising 14 railways in 14 out of the 18 provinces. In addition there were 11 provincial and private railways (some owned by mining companies) aggregating 425 mi. and five concession lines aggregating nearly 2,300 mi. These figures are given in the report on the government railways by the Ministry of Communication, Republic of China, for the calendar year 1918.

Taking the 18 provinces as a whole, there are about 460 sq.mi. of territory and 107,000 population per mile of railway. These figures compare with 40 sq.mi. and 8,000 population for India, and 12 sq.mi. and 3,800 population for the United States. It is stated in the report that owing to the extent of waterways in China these average figures always will be higher there than in other countries.

The construction cost for the government lines has averaged $126,000 per mile, ranging from $80,000 to $145,000. There are only 13 mi. of double track, but sidings and industrial lines raised the trackage to a total of nearly 4,300 mi. The equipment included 653 locomotives. Owing to the fact that equipment must be purchased abroad, the policy is to extend the life of the engines as long as possible by means of extensive repairs and renewals, rather than to purchase new ones. Operating expenses were 44 per cent of operating revenues. The traffic consisted of 25,475,379 passengers and 18,551,684 tons of freight.

Measuring Upward Pressure Under a Masonry Dam

Tests Made on Island Park Dam at Dayton, Ohio, to Determine Extent of Under Pressure Through Porous Foundations

By E. W. Lane and E. L. Chandler
Assistant Engineer and Assistant Division Engineer, Miami Conservancy District, Dayton, Ohio

FEW data regarding tests of upward pressure under masonry dams and similar structures on porous foundations have been published. The experiments described in this article were conducted with the idea of adding to the meager fund of information available and to afford a more reliable basis for the methods now followed in estimating such pressures.

The determinations were made at Island Park Dam in Dayton, Ohio, the dam having been built across the Great Miami River in 1917 as a part of Dayton's park system. Fig. 2 is a photograph of the dam under low water conditions. Fig. 1 is a general plan, the location

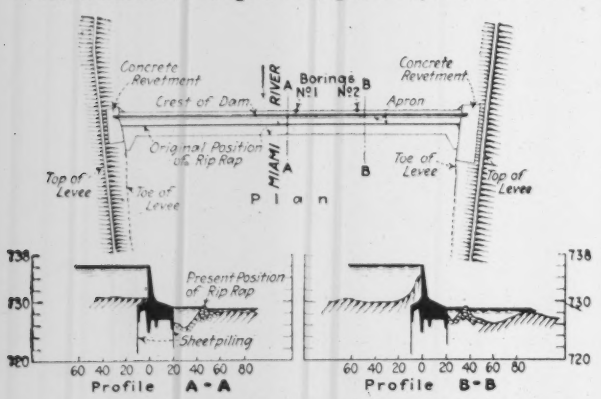


FIG. 1. PLAN AND PROFILES OF ISLAND PARK DAM, MIAMI RIVER, DAYTON, OHIO

of the two sets of test pipes being shown by the lines *AA* and *BB*. The topography both above and below the dam in the vicinity of the testing apparatus is shown in Fig. 3 and in Fig. 1 is a profile along the line of each set of test pipes. The irregular form of the stone riprap will be noted in these profiles and also on the topographic map. As originally placed the riprap was in a layer about 2 ft. thick extending for a distance of 20 ft. downstream from the apron. The greater part of the stones adjacent to the apron have been displaced and piled in an irregular ridge with the crest about 20 ft. downstream from the edge of the apron, leaving the sheetpiling unprotected to a depth as great as 4 ft. in some places. The material upon which the dam was constructed is composed of sand and gravel with a slight intermixture of clay, as shown in Fig. 3. This diagram shows the result obtained from two of several borings made as a part of the investigation preliminary to the construction of the dam. The essential features of the design of the dam may be seen in Fig. 4. It is an over-fall type, gravity section, concrete structure. Features of the design are the fore-apron extending upstream from the overall section and the arrangement of the piling.

The apparatus for making the tests was installed by the Miami Conservancy District acting in conjunction with the Department of Public Service of the City of Dayton. B. M. Jones, now division engineer for the Lockington Dam, supervised the installation. The pipes were placed when the dam was built, and it was the intention to study the effect of the accumulating head behind the dam as the closure was made. The war activities, however, interrupted the program and the investigations were finally carried out during the summer of 1919 by the writers of this article. Since the construction of the dam, a blanket of mud had accumulated over the bottom of the pond. It varied in thickness from 2 to 8 in. and apparently exerted a very marked influence on the upward pressures. For this reason the variation and magnitude of pressures was found to be much less than would probably have been the case could observations have been taken before the formation of the mud deposit.

The apparatus employed was very simple. A system of 1-in. pipes was installed, extending from the top of the apron down through the concrete, to what were considered critical points beneath the dam. The arrangement is shown in Fig. 4. The lower end of each pipe terminated in a bag of coarse gravel to prevent the pipe from becoming clogged. The upper end was threaded and fitted with a coupling into which was screwed a plug. When an observation was being made each plug was replaced by a short length of pipe and elevations on the tops of these pipes were taken. The water rapidly came to a fixed level inside the pipes and its position was easily determined by measuring down from the tops. The elevation of the water thus obtained was an indication of the pressure underneath the dam, at the other end of the pipe, since that pressure was balanced by the water column created. Two sets of test apparatus were installed affording two independent determinations. Readings on each set were taken at several different times and the pressures obtained were so consistent that the results are evidently reliable.

Under ordinary conditions, the upward pressure beneath the dam at the lower end of a pipe, if expressed

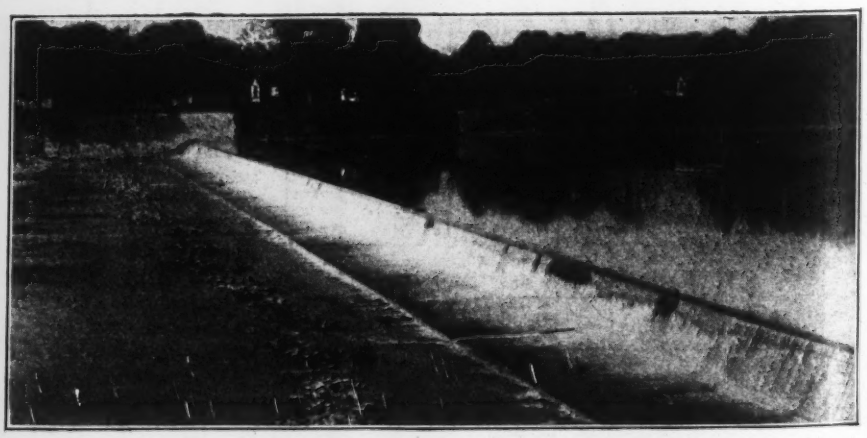


FIG. 2. ISLAND PARK DAM ON THE MIAMI RIVER AT LOW WATER STAGE

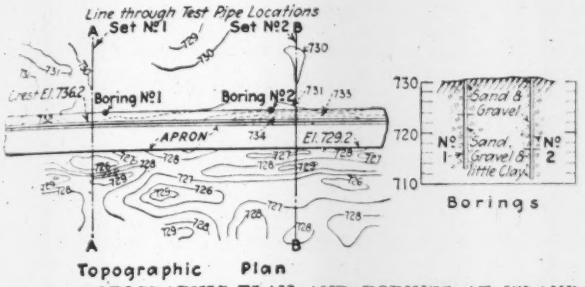


FIG. 3. TOPOGRAPHIC PLAN AND BORINGS AT ISLAND PARK DAM

in feet of water, would be equal to the difference in elevation between the under surface of the dam and the free water surface in the pipe. The results of the experiments are shown in Fig. 4 by the piezometric lines connecting the points above the lower ends of the pipes, the elevation of each point being that to which the water surface rose in the corresponding pipe. The pressure on the lower side of the dam at any point, under ordinary conditions, would be represented by the distance from the bottom of the dam up to this line.

An unexpected discovery was that gas was accumulating in considerable quantities beneath the dam. It escaped from several of the pipes, particularly from pipe No. 9 of Set 1. (See Fig. 4.) In a period of about a month between observations gas had collected so that the flow from a ¼-in. nipple connected into this pipe was sufficient to maintain a flame about a foot high for ten minutes. The flame was generally colorless, changing at times to light blue, its presence being always evident by reason of the heat generated. The gas was evidently methane, formed by the decomposition of slight quantities of vegetable matter in the gravel. The dam, because of its shape, acted as a gas holder. It is of interest to note that the gas confined beneath the dam increased the upward pressure, or the tendency of the dam to float. For example, if gas collected until it displaced the water above the lines *AB* and *A'B'* (Fig. 4), the upward pressure would no longer be represented by the distance from the bottom surface of the dam to the piezometric line, but by the distance from the lines *AB* and *A'B'* to the piezometric line. No actual measurements were made of the elevation of surface corresponding to lines *AB* and *A'B'*, but they probably did not fall below the positions shown. The possibility of increased pressure generated in the manner described should be considered in the design of structures of this type.

In Fig. 4 are shown the elevations of the piezometric lines as measured on the two sets of pipes. For Set No. 1, two lines are shown, one a full line and one dotted, representing the extreme conditions found in a number of observations taken at different times. For Set No. 2, only one line is shown, that line being typical of the conditions found. Some of the pipes that had become clogged, are represented by dashed lines.

The most noticeable result of the measurements was the low pressure indicated by pipe No. 10, the one extending above the upstream sheetpiling. This pressure is much less than would be expected from the elevation of the headwater above the dam, due undoubtedly to the presence of the blanket of mud previously mentioned.

After having made several observations on set No. 1, an attempt was made to remove the mud from the region just upstream from the pipes, thereby approximating the conditions which existed when the dam was built. To accomplish this a stream of water from a fire hose nozzle, acting under a head of about 75 lb., was employed. Sufficient result was obtained to raise the water column through pipe No. 10 to about the height of the head water level, indicating a fairly direct communication between the head water and the pipe. This had no appraciable effect upon the other pipes, however, and no line is shown on the diagram to represent the condition. Just what is to be inferred is not quite apparent. It may be that the channel created through the mud was so small that the flow through it became rapidly diffused after reaching the gravel, the result being that while it did have considerable effect on pipe No. 10 it failed to affect the pressure under the dam. Again, it may be possible that the upstream sheetpiling was so effective that the upward pressure under the dam was always small and that the piezometric lines shown also represent the conditions as they existed immediately after closing the dam.

An inspection of the results shows that, in general, a considerable drop in pressure was caused by the up-

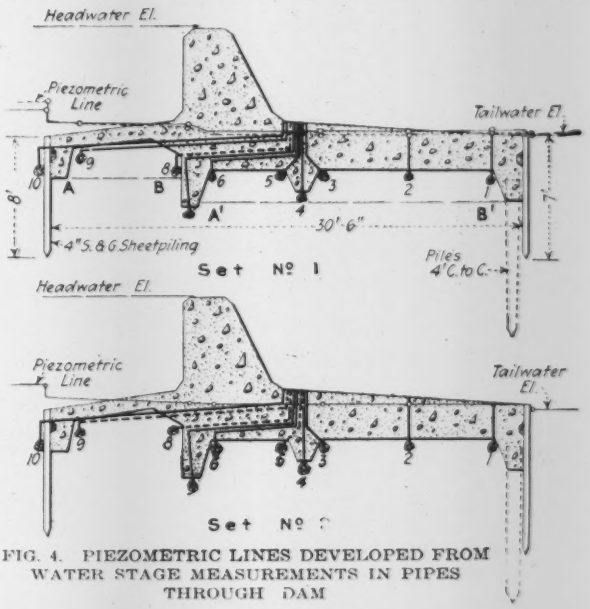


FIG. 4. PIEZOMETRIC LINES DEVELOPED FROM WATER STAGE MEASUREMENTS IN PIPES THROUGH DAM

stream sheetpiling, and a lesser one by the downstream piling. A slight drop in pressure also existed between pipes No. 9 and No. 7 and a somewhat larger one between No. 7 and No. 6. Between No. 6 and No. 1 there was no variation in pressure.

Probably the most widely used method of estimating the upward pressure under a dam with a porous foundation is based on the "line of creep" theory. According to this theory the flow follows the line of contact of the dam with its foundation. Where sheetpiling or cut-off walls are introduced, the flow follows down one side of the piling or cut-off, and up the other side. The path which the water takes is known as the line of creep. At any given point the distance of the piezometric line below the headwater elevation is the same proportion of the total drop between headwater and tailwater, that the length of the line of creep up to that point is of the total length of creep. If it is assumed that the effect of the mud blanket is eliminated by considering

that the elevation of the piezometric line at pipe No. 10 is the headwater elevation, it will be seen that the results agree only partially with this theory. It should be noted that the effects of gas under a dam is to decrease the length of the line of creep.

From these experiments it seems evident that although sheetpiling and cut-off walls are of value in reducing upward pressures, their effect is not necessarily in accordance with the line of creep theory. The results obtained are probably not representative of conditions existing immediately after the closure of the dam and it is therefore concluded that the greatest danger exists when the head against such a structure is first accumulated. The upward pressure may soon be reduced to an unimportant factor, the length of time required to bring about the change being dependent upon the rapidity with which silt is deposited over the bottom. It is also evident that the formation of gas under a dam is a potential source of danger if the shape of the structure is such as to confine the gas.

The fact that dams on porous foundations are being frequently constructed makes investigations of this sort valuable and the writers hope that further work will be done along the lines indicated in this article.

Recommend Closure of Atchafalaya River

UNDER orders of the Federal River and Harbor Act of 1916 and the Flood Control Act of 1917, a report has been made to the Secretary of War, and through him transmitted to the House of Representatives, on the problem of the control of the Atchafalaya River, which parallels the lower course of the Mississippi. At present the Atchafalaya is practically a continuation of the Red River, except that at their juncture an old channel of the Mississippi, known as Old River, diverts part of the Red River flow into the Mississippi and at times of high water diverts a part of the Mississippi River flow westward into the Atchafalaya and through its shorter channel to the Gulf.

A number of schemes have been proposed in the past fifty years to protect the land in the Atchafalaya basin. These include closing the Atchafalaya at its head and allowing the Red River to flow into the Mississippi, and closing off Old River and allowing the Red to flow down through the Atchafalaya basin, separating that basin entirely from the Mississippi flow. The current report, which was made by the Mississippi River Commission, indorsed by the Board of Engineers for Rivers and Harbors, and by Major General W. M. Black, then Chief of Engineers, U. S. Army, recommends the adoption of the latter plan.

This latest report contemplates the extension of the Tensas levee southward across the Old River to a connection with the Atchafalaya levee, a dam across Old River, a canal and lock to provide a navigable connection between the Mississippi River and the Red, and the enlargement of the Mississippi River levee to resist the additional flood height which would result below the juncture when the Atchafalaya would not be available as an overflow channel. The total estimated cost is over $13,000,000.

It does not appear from the report that any of the above concurring bodies or persons are particularly enthusiastic about the project. Each is merely stating, that provided something is to be done in the Atchafalaya delta, the scheme recommended is the best.

Details of Heavy Timber Framing

Derrick Tower Anchored to Pile Foundation—Base and Cap of Crane Runway Supports—Plank Trusses of Punch Shop

TIMBER framing found more extensive use during the rush construction of the war period than for many years before. Some ingenious and instructive details of framing were developed to meet the special needs arising. A few such details, taken from one company's practice, are set forth herewith.

One of the structures built for the New Orleans shipyard of the Foundation Co., where vessels of catamaran type are being built for the French government, is the rotating derrick with tower support described in *Engineering News-Record* of March 27, 1919, p. 638; here a special base detail was required for the tower posts, as

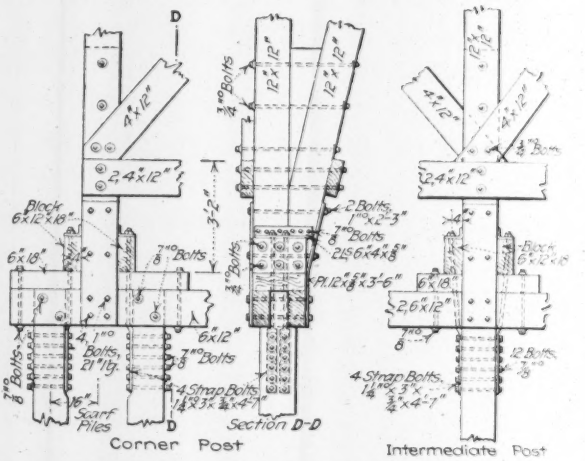


FIG. 1. BASE SUPPORT AND ANCHORAGE OF DERRICK TOWER POSTS

the posts had to be anchored to the foundation piling in order to provide for uplift. The detail was worked out by C. A. Wentworth, chief engineer of the company, on the basis of principles and methods used in structural steel detailing. Two other timber-framing details designed for the same yard are those of the A-frame posts which support a crane runway in the yard, and those of plank trusses carrying the roof of the punch shop.

At the location of the derrick towers the ground was too soft for direct footings, and as permanent foundations were not warranted on account of the relatively short time the derricks were expected to be in use, pile foundations were adopted. However, as uplift might occur under certain load conditions, it was necessary to anchor the tower posts directly to the piles.

The footing pile row is capped by two 6 x 12-in. clamps bolted to the heads of the piles, carrying a 6 x 18-in. rider. On the latter rest both the vertical post and the inclined or brace post of the tower leg, the inclined post being framed down at its end to a 6-in. width. The connection is stiffened against distortion by steel scabs, 12 x ⅝ in., connecting the posts with the pile caps. But the anchorage which could be secured through these plates was not sufficient for the uplift occurring under extreme conditions, and therefore a direct anchorage was provided. This consists of two brackets, each made of a 6 x 12 block capped with a steel angle, bolted to the sides of the post and engaged

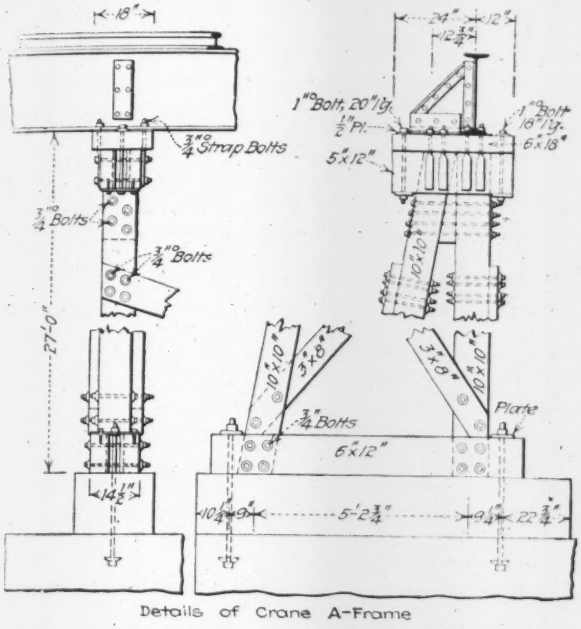


FIG. 2. BASE AND CAP OF A-FRAME POST OF CRANE RUNWAY

by 1¼-in. anchor bolts; the bolts pass down along the sides of the piles and have long strap ends, which are bolted to the piles. This detail leaves the strength of the cap unimpaired, gives a large bearing area for the downward load on the post, and at the same time transmits the uplift directly to the piles. Two of these bases are shown in Fig. 1, the two-pile foundation of a corner post and the one-pile foundation of a post at the middle of one side of the tower.

Anchorage against uplift had to be provided for also in the case of the A-frame posts of a traveling-crane runway. Furthermore, the post caps in this case had to be developed into a secure and rigid seat for the crane girder, capable of resisting any tendency of the girder to tip over. Both details are sketched in Fig. 2.

Each post consists of a plumb and a batter timber, connected to a single base. The sills are made of two 6 x 12-in. timbers spread about 3 in. and notched around the posts, which are gained to 5-in. thickness. The anchor bolts, set in the masonry foundation, pass between the two cap timbers and engage bearing plates resting on the caps. These bolts, together with the direct bearing of the uprights on the sills, take care of both downward load and overturning effect. The base was bedded in grout when the A-frame was set up, in order to give firm seating to the frame on the foundation concrete.

At the top of the posts the seat for the crane girder comprises two 5 x 12-in. clamp timbers engaging both plumb post and batter post, a ½-in. steel bedplate for the girder, and four strap bolts fastened to the sides of the clamp timbers and engaging the crane girder I-beams and its kneebrace. The girder is held securely by the steel kneebrace and the combination of steel bearing plate and anchor bolts, without play or lost motion, so that the detail takes care of both vertical load and horizontal thrust.

Plank construction was employed for the roof trusses of the plate-and-angle shop. The roof framing consists of triangular transverse trusses spaced 17½ ft. apart. As the wall columns are spaced 35 ft., lattice trusses in the line of the side walls were provided to carry the intermediate roof trusses. The lattice trusses as well as the roof trusses are built up of planks (Fig. 3). The ends of the roof trusses are detailed so that they fit either at the post or at the mid-vertical of the side-wall truss without any change.

In both trusses the plank web members enter the 4½-in. space between the two planks forming each chord. As the webs are 2½ in. thick, two web members of opposite inclinations can lap at the ends as well as at intersections without any cutting. The chord splices in these trusses are designed to develop about two-thirds of the total strength of the stick spliced; the bolts are figured to carry 3000 lb. each.

At the ends of the roof trusses the chords are made solid by filler blocks, and the top chord is notched into the bottom chord. Scabs bolted to the outside, and diagonal bolts downward through the two chords further secure the joint. A bolster block under the bottom chord is also bolted vertically through both upper and lower chord, and provides a solid bearing surface for the top of the post.

A steel angle seat bracket on the inner face of the post is bolted through the full depth of the truss; on the outer face of the post are fastened strap bolts which pass up through the truss and the eave purlin, so that the truss is secured firmly. Kneebrace planks are bolted to the outside of truss and post. Both the truss seat and the kneebrace fit either the post or the side-wall truss vertical.

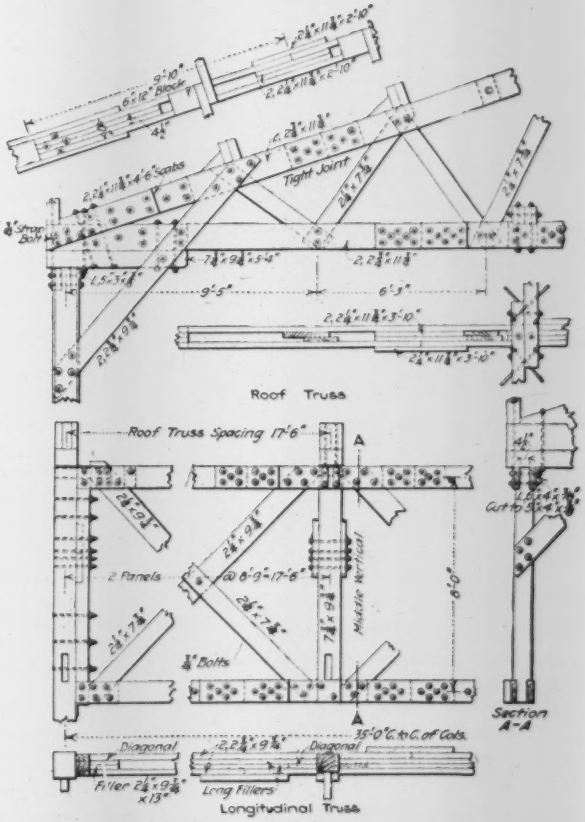


FIG. 3. PUNCH SHOP ROOF TRUSS DETAILS

Similar details of construction are used in the side-wall truss itself, which is also illustrated in Fig. 3. The economy in size of joint secured by lapping the web members is especially apparent in this truss. Of particular interest is the connection of the truss to the post which is a plain bolted face connection.

A Simple Mechanical Control for Dosing Sewage Beds

By Perry Thompson
City Sanitary Engineer, Yonkers, N. Y.

With a view to designing for contact beds an inexpensive, positive mechanical control without small air or sewage pipes to become clogged by grease or rust scales, and not dependent on a nicely balanced air or water pressure, and which would neither require the payment of a royalty nor the employment of specially trained men for installation, the writer recommended to a land company the device and general plan shown herewith. The company wished to construct an inexpensive, inconspicuous and somewhat temporary system of sewage disposal consisting of settling tanks followed by primary and secondary contact beds, the effluent to enter a stream where dilution was quite ample.

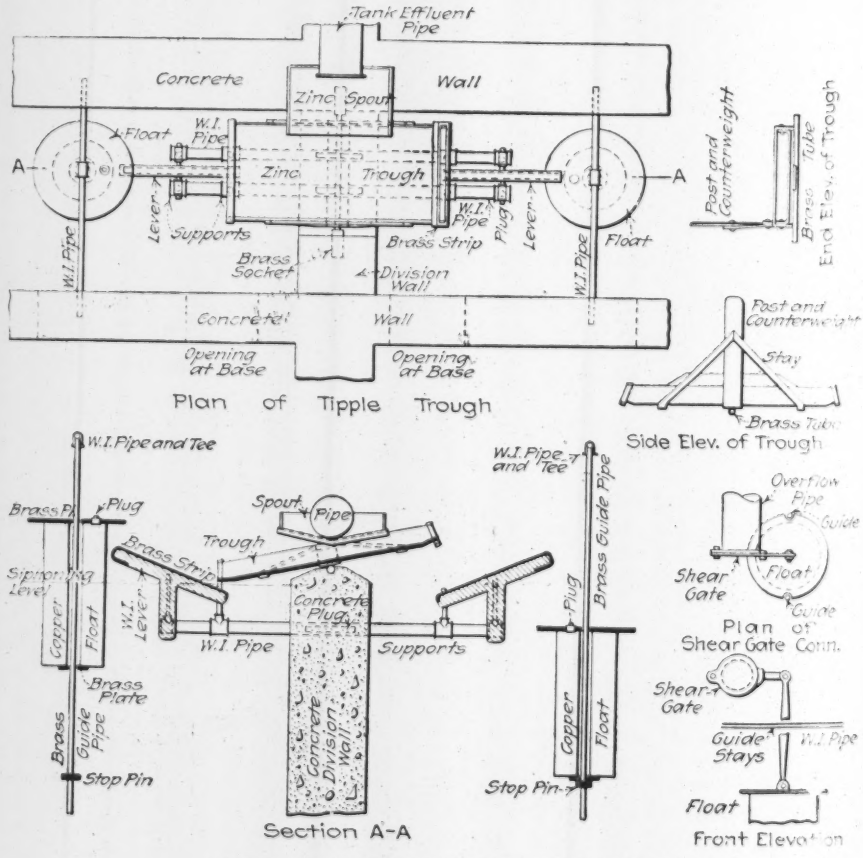
The "tipple-trough" is not altogether new. A similar one was designed by the writer for a large institution at Chappaqua, N. Y., where it has operated satisfactorily for several years. As may readily be seen, its usefulness is not confined to contact beds.

Briefly, the operation of the system is as follows: Sewage from either or both settling tanks falls from the spout into the trough which we will suppose to be tilted toward the float chamber connected with primary bed 1 and to be held in that position by the counterweight arm till the bed is full and the siphon has lowered the water level and the float sufficiently for the latter to tip the trough so that the flow will enter the float chamber connected with primary bed 2.

While primary bed 2 is being filled slowly from the trough, secondary bed 1 is being filled rather rapidly by the siphon in primary bed 1, but the latter flow is not sufficient to cause the siphon in secondary bed 1 to start because the capacity of the secondary beds is a little greater than that of the primary beds; the sewage is therefore held in contact while primary bed 2 is filling to the overflow point. As the sewage in secondary bed 1 rises it causes the float in the chamber connected therewith to rise and thereby open a shear gate on the end of the overflow pipe from primary bed 2. When the sewage in primary bed 2 has risen to this point it therefore flows into secondary bed 1 for a very brief time until the siphon in the latter bed has lowered the sewage there and the float in the chamber connected therewith sufficiently to close the gate, while primary bed 2 continues to fill till its siphoning level is reached and the lowering sewage has carried down the float in the chamber connected therewith and tipped the trough back toward set 1. As the sewage rises in secondary bed 2 it causes the float connected therewith to open the shear gate on the end of the overflow pipe from primary bed 1, so that this overflow may later come into play and cause secondary bed 2 to be filled to the siphoning level, after which the descending float connected with the latter bed shuts off the sewage which rises in primary bed 1 till the siphoning level is reached, and thus the operation goes on continuously and automatically.

No dimensions are given because they will vary with the amount of sewage. The net capacity of the primary beds should be from 2 to 4 hours flow when new, according to the time of day, the local conditions and the quality of the settling tank effluent.

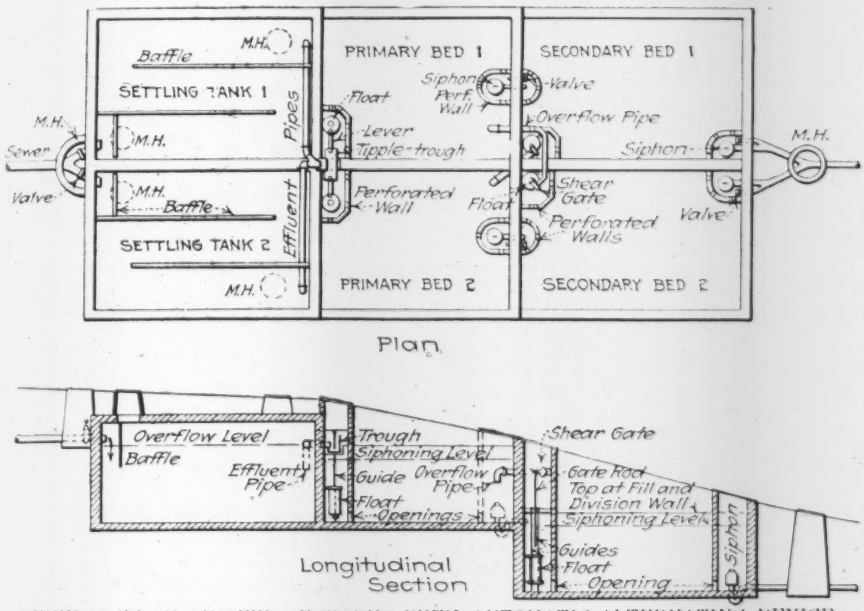
The capacity of the secondary beds should be about 15 per cent greater than the primary beds, according to the adjustment of floats, the promptness of siphonic action, etc. The elevation and size of the overflow pipes will also vary according to the amount of sewage and



ALTERNATING DEVICE FOR SEWAGE-WORKS

Where the fall is plentiful the trough may be deeper and narrower than here shown and the spout may be omitted, especially if the volume of effluent is small.

the length of contact desired. The overflow can be made adjustable by being set in watertight slides provided with means for fastening securely. Of course the connecting rods from shear gates to floats would also have to be adjustable. All parts of the controlling apparatus except the pipes which secure the float-guide pipes, the main portions of the levers, the lever support pipes, the overflow pipes, the siphons and the bodies of the shear gates, should be made of brass, copper, zinc or other non-rustable metal. By a judicious selection of brass pipe and tubing almost any size of guide, shaft, axle or socket may be obtained. The float chamber and siphon chambers should be covered, at least in winter.



GENERAL PLAN OF SEWAGE-WORKS WITH AUTOMATIC ALTERNATING DEVICE

Portion of East Cleveland Zoning Ordinance Upheld

THE provision of the zoning ordinance of East Cleveland, Ohio, that prohibits the building of apartment houses in certain areas of the city was upheld in the Court of Common Pleas, County of Cuyahoga, Ohio, on April 30, in a decision handed down by Judge Kramer (State of Ohio, ex rel, Max Morris vs. C. M. Osborne, city manager). East Cleveland is a suburb of Cleveland with a population of some 30,000. On July 15, 1919, the City Commission passed an emergency dividing the city into four building zones. Zone "A" is the industrial zone and is unrestricted; "B" is the business zone and is restricted against manufacturing of all kinds; "C" is the apartment zone and is restricted against manufacturing and business; "D" is the private dwelling zone and is restricted against manufacturing, business and apartments.

The case in court arose on the refusal of the building inspector to issue a permit for the erection of eight apartments in a zone restricted to one- or two-family dwellings. The case had previously been before Judge Foran, who sustained the validity of the zoning ordinance (Ohio Law Bulletin, March 15, 1920, p. 98). The case was not fully argued before the Judge and no evidence was submitted by either party. On rehearing the city submitted evidence to show the relation of the zoning ordinance and the restriction against apartment houses in particular to the purposes for which the police power may be exercised. Testimony was given by C. M. Osborne, city manager of East Cleveland; Dr. Haven Emerson, former health commissioner of New York City, on the relation between the apartment and the public health; Robert H. Whitten, advisor, Cleveland City Plan Commission, on the general advantages of a zone plan and the need of keeping apartments out of the one- and two-family house section, and by Paul Feiss, chairman of the Housing Committee of the Chamber of Commerce, on the relation of apartment house limitation to the general housing problem. Practically no evidence was submitted in rebuttal by the relator. Excerpts from the decision follow:

It would seem that there could be no two opinions upon the proposition that the apartment house, or tenement house, or tenement, in a section of private residences, is a nuisance to those in its immediate vicinity. Under the evidence, and as a matter of common knowledge, of which the court may take judicial notice (16 Cyc. 582), it shuts off the light and air from its neighbors, it invades their privacy, it spreads smoke and soot throughout the neighborhood. The noise of constant deliveries is almost continuous. The fire hazard is recognized to be increased. The number of people passing in and out rendered immoral practices therein more difficult of detection and suppression. The light, air and ventilation are necessarily limited from the nature of its construction. The danger of the spread of infectious disease is undoubtedly increased, however little, where a number of families use a common hallway, and common front and rear stairways.

The erection of one apartment house in a district of private homes would seriously affect only those persons living in the immediate vicinity thereof, but the common experience is, that the erection of one apartment drives out the single residences adjacent thereto, to make way for more apartments. The result is that, in time, and not a very great time, when one apartment is erected, the whole street is given over largely to apartment houses.

With the growth of its population, it appears to be practically certain that unless restricted, the greater part of East Cleveland will be built up with apartments, and the home owners must choose either to adopt apartment life or abandon their depreciated property, and move out of the city or into its more remote parts.

If the claim of the relator here is sound, a city of private homes, grass plots, trees and open spaces, with the civic pride and quality of citizenship which is usually found in such circumstances, is powerless to protect itself against the obliteration of its private residence districts by apartments, which shut out the sun and sky from its streets and one another, and are generally owned by those whose greatest interest is in the revenue that the building will produce. If such is the law, it must be conceded that it is unfortunate.

The apartment house is, for many, a desirable convenience, and, for some, a necessity. They are a recognized necessity in cities of any size. Their erection should not be prohibited, and under this ordinance, are not prohibited.

Private residences, with yards for play spaces, with grass, trees and flowers, are necessities for people with children, and as much a convenience to the people without children, who take an old-fashioned pride in owning their homes, as is the apartment to those who are willing to accept its restrictions, for its compensatory freedom from responsibilities. It is at least equally important to the community to preserve the private home for this class, as it is to provide the apartment for the first. Under this zoning ordinance, both the private home is preserved and the apartment house is provided.

It seems eminently fair to restrict the apartment builder to a limited area, where his use of his property will do the least damage to others, and to the community. The necessities or convenience of those who live in them will be served thus with the least sacrifice of the necessities and conveniences of others. Whatever of the burden arising from apartments there are will be borne by those whose purposes they serve, and not shifted to the other property owners of the city, to make their property unfit for use as a home.

* * * *

This court is therefore of the opinion, first, that the ordinance here in question is a valid exercise of the police power by the city of East Cleveland, under the authority of its charter; second, that it has not been shown that the classifications made under this ordinance are unreasonable, arbitrary, discriminatory and not uniform in operation.

The petition of the relator therefore will be dismissed, and an exception given.

Fire Protection Equipment and Pumps for Large Buildings

CENTRIFUGAL pumps for fire service should have not more than four stages according to amendments to the specifications for fire pumps adopted at the recent annual meeting of the National Fire Protection Association in Chicago. Although certain advantages of the multi-stage pumps are recognized it is important to secure simplicity of design. Two or more stages should be provided where pressures above 100 lb. are required. The committee on fire pumps also submitted requirements for pumps driven by gasoline engines. Rules for supervision and care of valves controlling water supplies for fire protection were adopted practically as submitted by a committee. One of the most effective methods of insuring proper maintenance of such valves is said to be securing them in the open position by a seal which must be broken before the valve can be closed. Alternative methods including electrical valve indicators, signal devices and recording systems are also covered by the report of the committee on valve practice.

Safe construction and equipment of apartment houses was the subject of a report by the committee on building construction. It includes buildings of brick, tile, concrete and concrete blocks, but bearing walls of hollow brick and concrete blocks are limited to 45 ft. in height. Columns and floor framing may be of steel or concrete, with slab floors or girderless concrete floors. The handling of explosives and inflammable liquids were among the subjects considered and there was an illustrated address by J. W. Stevens on intensive work in fire prevention. One afternoon was spent at the Underwriters' Laboratories, inspecting the apparatus and the various tests in progress.

Officers elected include the following: President, W. E. Mallalieu, New York; vice-presidents, H. O. Lacount, Boston, and W. C. Robinson, Chicago; secretary, Franklin H. Wentworth, Boston, Mass.

Belt Line Suggested to Ease N. Y. Terminal Congestion

Supremacy of New York Port Depends Upon Action to Lower Terminal Cost, Says Col. Wilgus

CREATION of an outer belt line linking all of the rail carriers of the Port of New York with each other and with the water front, and the unification of the management of all transportation facilities within its circumference, including inner belt lines, water front development of public nature, and the portion of the lighterage fleet retained for terminal service that must be continued to be handled by water, were urged as a means of reducing the terminal cost in the Port of New York by Col. William J. Wilgus in a paper, "The Railroad Problem in Relation to the Metropolitan District," read at the annual meeting of the New York Section, American Society of Civil Engineers, May 12, at the Engineering Societies' Building, New York City. Upon some such general plan for connecting the main lines of the eight railroad systems entering New York outside the zone of greatest congestion, whereby passengers and freight could be freely transferred, and upon co-ordination among the several carriers, depend the supremacy of New York as a port, asserted Col. Wilgus.

As primary causes why New York is sometimes referred to as "the terminal sore spot of the United States" and why terminal charges here range as high as $35 a car load in comparison with $2.50 in San Francisco and even lower terminal costs in other ports, Col. Wilgus assigned the following reasons: First, a lack of co-ordination between the carriers; second, the interposition of a water barrier between the mainland and the leading centers of the port, which imposes on the rail carrier the burden of effecting its collection and deliveries by means of water-front operations on both shores, plus lighterage; and third, the requirement in the seaboard rate that "the land carrier shall deliver and receive freight at ship side, thereby removing the incentive to the owner or lessee of the pier—the water carrier—to advocate more efficient interchange facilities from which the major benefit will go to those who do not share in the cost of providing them."

Public Interest Demands Action

Public interest, declared Col. Wilgus, demanded that these obstacles to progress be overcome, and as a personal plan he suggested the creation of an outer belt line which might extend from the New York Central in the vicinity of Yonkers westerly to the West Shore R.R. near Dumont; thence continuing west to the rear of Paterson, N. J., intersecting the various lines of the Erie and Delaware, Lackawanna and Western railroads; thence southerly along the Passaic River to a crossing of the divide near the Delaware, Lackawanna and Western R.R. at Summit, N. J.; thence southerly and easterly via South Plainfield to Perth Amboy, N. J., intersecting the Central R.R. of New Jersey, Lehigh Valley R.R., Philadelphia and Reading R.R., and Pennsylvania R.R.; thence northeasterly across Staten Island to Stapleton, where connection would be made with the Baltimore & Ohio R.R.; and thence under the upper bay to Bay Ridge on Long Island, from which connections would

radiate to the Brooklyn water front to Jamaica Bay and via the Long Island and New York connecting railroads to points in Long Island and the Bronx. Such a route he asserted would enable railroads to interchange freight and passengers freely, as well as troops and supplies in times of war or insurrection, at points remote from the congested regions of the port. Delivery of them would be possible then without the "expensive and uncertain intermediary of harbor floatage," would be possible direct to bottoms along the water fronts of all sections of the port, save Manhattan.

Inasmuch as transshipment of Manhattan freight from standard railroad car to distributing vehicles is necessary Col. Wilgus asserted that it should be done not on costly property, among congested surroundings at concentrated localities as near as possible to Broadway, but should be done at trunk line termini somewhere in the New Jersey meadows. Breaking bulk on the New Jersey side would therefore eliminate transference of New England freight to the Manhattan side. From the New Jersey side the Manhattan bridge could be carried in trains of electrically operated multiple-unit vehicles beneath the river, and through small subways near the surface to and from any points of the city where there would be direct contact with the large shippers, or where mechanical devices would transfer the removable containers from the subway vehicles to motor truck chassis for short-radius door to door delivery. With the adoption of some such general plan as Col. Wilgus indicated, he asserted there would be a policy of diffusion rather than concentration of market products, fuel and other freight. A valuable part of the water front would also be released for legitimate water-borne commerce. Relief of street congestion would be a natural result.

Bridges Over Hudson Probable

The vehicular tunnel now proposed by New Jersey and New York could not be considered as a means of solving Manhattan's freight distribution problems, but merely looked upon as a street extension across the river. Hudson River bridge crossings near 59th St., and near Fort Washington, for the accommodation of pedestrians, motor vehicles and joint trunk line traffic, were also deemed probable.

Col. Wilgus also referred to the twelve Staten Island piers, contracts for the construction of which have been recently let. He expressed the hope that even yet something might be done to change the design of those piers not only to provide sorting and temporary storage space but also comprehensive track layouts and motor truck hauling accommodations. The construction of craneless piers at Staten Island were said to be regretted particularly in view of the future operations of the Erie Barge Canal which are unequipped with self handling cargo devices and in view of "the surety that in case of war, many kinds of cargo must be handled here for which the ordinary ship tackle would be unsuited." The reason why such design was determined upon, apparently he finds in the fact that the plans were made to suit the wishes of the prospective lessees, the steamship companies, whose policy "very naturally is dictated by self interest rather than a general good."

Despite the urgent need for a revision in terminal policy Col. Wilgus says that such a radical change as outlined above would be predicated upon a solution of the general railroad problem by the nation in such a manner as to ensure harmony between railroad managers and employees and the public at large, so that capital would again flow into the expansion and extension of railroad systems. Pending such a comprehensive solution he expressed the hope that any work done by local communities would be carried out with the idea in mind that all agencies and individuals concerned would be considered rather than any special interest.

Members of the New York section, after discussing Col. Wilgus's paper, declared it to be of such importance that wide circulation of it not only among engineers but among all agencies and individuals interested in the future of New York as a port would be highly desirable. Through a motion the Board of Direction was given power to act in connection with that matter as well as in conferring with the proper officials over a proposed revision of the Staten Island piers.

Compensation of Chinese Engineers

By R. D. Goodrich

Engineer in Charge of Works, Commission for the Improvement of the River System of Chihli, Tientsin, China

THE accompanying schedule of salaries (paid in 1919) of the Chinese engineers employed by the Commission for the Improvement of the River System of Chihli, may be of interest in connection with the current discussion of the compensation of engineers. Although there is less engineering work in China now than formerly and salaries are somewhat lower, they are still able to command what would seem to us at home a high level of salaries. It should be noted that these salaries are for engineers on surveys and that some instrument men are receiving as much as $250 a month with an added allowance of $80 to $100. These salaries are in local currency and may be converted into gold at the present rates of exchange by deducting about 10 per cent. Of course under pre-war conditions, with silver and gold at rates of 2 to 1 or more, the comparison would be very different.

The schedule is as follows:

TOPOGRAPHIC SURVEY STAFF

Grade	Initial Salary	
Chief of party	$400	An increase of $25 each year to a maximum of $500.
Engineer surveyor	250	An increase of $25 each year to a maximum of $350.
Assistant engineer, 1st grade	180	An increase of $15 each year to a maximum of $225.
Engineer surveyors and assistant engineers first grade are also promoted by selection to fill vacancies in the complement of grades above them.		
Assistant engineer, 2nd grade	$150	An increase of $15 after one year and promotion in grade after two years.
Assistant engineer, 3rd grade	120	An increase of $15 after one year and promotion in grade after two years.
Cadet, 1st grade	75	An increase of $15 a year for two years and promotion in grade after three years
Cadet, 2nd grade	60	Promotion in grade after one year.
Draftsman (tracer)	60	An increase of $15 each year to a maximum of $120.

HYDROMETRIC SURVEY DEPARTMENT

Hydrometric surveyor	$200	An increase of $25 each year to a maximum of $300. The senior hydrometric surveyor receives a charge allowance of $25.
Assistant hydrometric surveyor	100	An increase of $20 each year to a maximum of $200.
Draftsman	60	An increase of $15 each year to a maximum of $120.
Observers	60	An increase of $15 each year to a maximum of $120.

In addition, field allowances amount to about 25% of these salaries, besides transportation paid.

Convention of the American Association of Engineers

Abstracts of Addresses and Reports Presented May 10 and 11 at the St. Louis Meeting of One Hundred and Forty Delegates from One Hundred and Thirty-three Chapters.

Organization and Work of the A. A. E.

By Prof. F. H. Newell
Retiring President, Urbana, Ill.

WHY is it that the American Association of Engineers, the youngest among so many engineering societies, has grown so strong? The reason is summed up in the word "Service." It is because it is trying to carry out the principles of true democracy and fellowship among the rank and file of professional engineers; because it is bringing them together to study the human factors, to consider the relations of man to man in industry and in economic affairs, and to work for each other and for the greatest good to the greatest number, co-operating with all, but not losing time by waiting for any. It is this spirit which is the strength of the organization.

During the year which has elapsed, the membership has increased from 4,000 to 17,000. The number of clubs has grown from 11 to 49 and of chapters from 21 to 133. The secretarial or clerical force for handling the rapidly increasing correspondence and routine work has increased from 20 to 75. The approximate amount of money received during the year has been $170,000. Practically all of this has been re-invested in the active work of the organization, as it has been the policy of the association to make returns to the members as quickly as possible through the services which may be rendered. Our official organ, *The Monad*, published in an edition of 5,000, has been transformed into the *Professional Engineer* with an edition of 20,000. Our employment service has received 5,000 inquiries, and has placed 1,800 persons, with a saving to them, as computed on the basis of the commercial employment agencies, of $200,000. This has been at an approximate cost of $10,000. In publicity, the local chapters and the Chicago headquarters have sent out material which has been reproduced in thousands of papers, each item calling attention to the engineer as a factor in human society.

Organization—Out of the recognition of the adage that "the Lord helps those who help themselves" has come our present association, originated and maintained by men who are determined not to rely upon others, nor to wait for some older society to awake to their needs, but to get together and make an effective agency for self help—and for service to humanity. By experience there has been learned the un-wisdom of waiting for others to do those things that can be best done ourselves—depending on our own courage and initiative.

The form of organization has necessarily been elastic, adjusted from time to time to fit the rapidly changing numbers and needs. In fact, the growth has continually forced adjustments. At all times, however, the local club or chapter has preserved its initiative and vigor.

This form of organization of A. A. E. must necessarily be one which will permit engineers to meet as often as practicable and to become acquainted with each other so that they may work in unison and in groups throughout all portions of the country. This results in the formation of clubs of a few engineers, meeting together in each smaller city, or in a large construction camp. Some of these clubs, favorably situated, grow rapidly into chapters composed of from 20 to 1,000 members, men who assemble at frequent intervals in the large cities, appoint committees and sub-committees to take up matters of common interest. These chapters propose to meet periodically in state assemblies, whose functions are similar to those of the old state engineering societies; also they are grouped into districts for the convenience of administration.

Chapter Work—Upon the effective work done by the individuals in each and every chapter depends largely the success of the A. A. E. While national headquarters may handle the larger problems and those of nation-wide interest and may systematize the details of employment, the preparation of information on salaries, the publication of news to the members, and correlate interests all along the line, yet it is in the chapters that the detailed work is accomplished; there the members get together and discuss the details, educating each other and producing in the aggregate the results for which the organization has been formed.

In some localities there already exist local sections of older technical societies and independent organizations. This results, temporarily, at least, in an apparent duplication of organiztion, but this condition is being remedied by the fact that there is usually a large enough number of engineers, not yet members of any society, sufficient to bring about a consolidation into the more vigorous and purely democratic chapter of A. A. E. In this way there have already disappeared a number of small engineering societies, these being replaced by live chapters of A. A. E., devoted to social, economic and civic affairs of interest to all.

All welfare work to be successful must be conducted from the ground up; it must be thoroughly democratic, and not a matter of authority nor of effort conducted by the best people, or those at the top reaching down in well meant efforts to help the man below.

Questions have been asked as to whether there is likelihood, if pending changes are made, of the overlapping of activities of the A. A. E. and of Engineering Council or other bodies representative of the older technical societies. It is hardly probable that under intelligent direction and with a proper display of the co-operative spirit, that there can be any such overlapping. There may be, it is true, some competition, but in such cases it is believed that the stimulus to effective work will be far more valuable than any loss which comes through apparent duplication.

Practical Efforts—The operations by which A. A. E. is seeking to carry out its ideals of service to the members and the public may be classified as pertaining mainly to employment, salaries, education or publicity, ethics, legislation and responsible control. No matter how able the engineer may be or how much time and money he may have expended on his education, or how wide his experience, all of these fail of utility to the world and are like a crumbling building on weak foundations unless he has work.

Recognizing this condition, the American Association of Engineers has made as one of its first and fundamental duties that of endeavoring to study working conditions in a broad way, and specifically to aid its members to the end that each man may find an opportunity for the best exercise of his qualifications. Thus it is that the employment service has been, and probably will continue to be, one of the most important functions of the association and of its chapters and clubs.

The association has succeeded in greatly improving the conditions of men in railroad employ. In the same way, in the case of public servants, notably in municipal engineering offices, and in highway construction, it has developed the existing facts, and has presented fair schedules or statements of minimum requirements which are being widely accepted. It is giving attention to another very deserving class of its members, namely, the engineering educators.

The work of the local chapters is largely educational in the sense that it serves to a certain degree as a post-graduate course for men who have passed through college or through the hard school of experience and who, getting together, exchange ideas and educate each other in various lines of mutual concern. More than that, in some of the chapters, steps are taken to maintain courses of instruction which are found by the members to be of peculiar ad-

vantage to them. Notably is this the case in public speaking where classes have been formed to give the members opportunity to discuss among themselves the matters of common interest and to improve in their methods of presentation of facts to all kinds of people.

The object to be attained in publicity is to let the public know something of the elementary facts regarding the work of the engineer, so that, appreciating these, better support will be given to engineering work in general. It is not intended to advertise any one engineer, but on the contrary to build up such an understanding of the possibility of further development of engineering for the public good that the plans and efforts of engineers will be supported by the public, particularly in lines which lead to better health, better comfort, and increased prosperity; through the development of highways, railways, means of transmitting intelligence, light, power, water supply, drainage, irrigation and other infinite applications of mechanical electrical and chemical forces.

Without such knowledge, systematically diffused in easily understandable form, the public and the men in control of large affairs are often unaware of the simple fact that society depends upon the engineer for most of its modern necessities.

The effort is continually made to keep before our membership the ideals of higher ethical relations between engineers and in their dealings with the public. This can best be done by bringing all of the engineers concerned into the organization, and then having these matters considered by properly qualified practice committees. It is by no means easy to rectify the abuses or neglect of a generation, but it is none too soon to begin systematically on the examination and correction of some of these matters.

The A. A. E. has co-operated in the general movement for a federal department of public works, and has urged that the next Secretary of the Interior be an engineer. This is indicative of similar efforts being made all along the line to insure that qualified engineers be given full responsibility for large executive departments.

The Present Activities and Future Responsibilities of A. A. E.

By C. E. Drayer
Secretary of the Association

Employment—The employment department has been placing members in such numbers that the saving, upon the basis of charge by a commercial agency, is more than the total receipts of the association from fees and dues. Last month 300 men were placed—an annual rate of 20 per cent of the entire membership. Men have been taken from misfit jobs and put where their abilities and inclinations fit. Increases in salaries have been obtained by offers of new positions.

Between 40 and 50 per cent of the positions filled are in the Chicago district. Of the calls for employment service at headquarters between 70 and 80 per cent are from Chicago members. This indicates that employment service is largely local and that it should be offered by every chapter. A way will be found to give it.

Compensation—The success of A. A. E. in the railroad field and, in a much less degree, in the municipal and other fields is well known. There are those who would check our endeavor to get the engineer an adequate salary but instead my hope is that we can give the same special attention to the public service, industrial and teaching fields as we have and are giving, to the railroad field.

Legislation—A major activity of the association as provided in the constitution is to supervise legislation affecting engineers. No legislation affects engineers more intimately than licensing. There are plenty of good license laws in operation or proposed. A. A. E. has obtained the passage of a good law in Virginia and has one in New York before the governor. Activities are under way in a number of other states. The time is nearly here when the engineer in the state not having a license law will be under considerable handicap.

Publicity—The opportunity for publicity work, not only from headquarters but abroad especially by the chapters, challenges the imagination. A few realize the potentiality of this service, not only to the engineer but also to the community. It is to be hoped that during the present year a man may be added to the staff who will give his time to this one major activity.

Welfare Work—Article 2 of the constitution provides that the association shall take action necessary to safeguard the profession's welfare. This broad province might be considerably subdivided. If we can insure health and happiness in a considerable degree to our membership we will be fulfilling one of the fundamental objects of the association. Not long ago a former chief engineer of a large railroad died at the age of 70 after several years of bitterness and dissappointment due to reverses that had overtaken him in his old age. No one wanted to employ the old man, especially with his discouraged attitude of mind. Wouldn't it be worth while to try to find a way to ameliorate such a happening?

In modern days life, health, accident insurance and old age pensions are looked upon as having their proper place in protecting against certain types of misfortune. The engineer is especially a safe risk and in a mutual company should be able to carry insurance at a favorable premium. A proper investment for the funds from insurance would be an office building, the permanent home of A. A. E. It is recommended that the association make a study of insurance and pensions with a view of offering to the membership the advantages arising therefrom.

Ethics and the Practice Committee—Last year the association brought out the "Engineers' Applied Ethics." Many of our ablest and highest minded engineers have commented upon it and all pronounced it excellent and surpassed by none. "The Engineers' Applied Ethics" should be so well known to all of us that we should be able to quote from it at will.

No law, however good, is self enforceable, so we have the Practice Committee, created at the last convention, to interpret the code in the problems met in practice and to enforce it. Because of several questions that have arisen during the past year in A. A. E., and because of the experience observed in other organizations, it has been suggested that a final tribunal in matters of ethics and practice be provided. This is eminently sound.

Unity Plan—The Board of Directors at its meeting Feb. 4 approved the recommendation of the national membership committee that members of recognized societies be admitted for one-half the current entrance fee. This plan commends itself as the quickest way to bring about unity and effective co-operation in the United States through the instrumentality of the organization designed to this end.

Evidence of the soundness of such a plan is best found in its operation. During April approximately 30 per cent of our applications (other than student) were on unity plan blanks. These applications are mostly from members in our local and state societies. Obviously the continuance of this plan for the remainder of the year will result in the initial integration of most societies, except the national technical societies, under the banner of A. A. E. Co-operation with the national technical societies will also be made much easier.

Reorganization—The founders of A. A. E. were men of unusual vision but few, if any of them, foresaw the wide reaches of A. A. E. of today and of the years just ahead. There are now some 200 subordinate organizations divided roughly into 150 chapters and 50 clubs. Little imagination is required to see that number soon doubled. Some of the chapters will number in the thousands.

The reorganization problem is one for experts to study before submitting a plan to our chapters. The center of the circle is service—the greatest service possible to the members and through them to the community. Clearly, the chapter is the unit, yet the unit must be supervised and correlated for the service of the whole. The plan of organization should be simple, ensure full control and fix responsibility.

For Americans the tried and satisfying type of organiza-

tion is a duplication of or a parallel to our political organization; the indivduals gathered together in the community group, then co-ordinated by states and the states into a national organization, yet through the whole a myriad of threads from the individual to national headquarters, tying all together in a mighty whole.

Headquarters can best serve by becoming an organization of experts, not only to advise but having full authority to direct. No more should headquarters be irresponsible to its members than should chapters be irresponsible to headquarters. Chapters should be checked up and the highest degree of service maintained in a business way. Leaders must be developed. This program calls for talent in the employ of the association. In our judgment, first the number of district secretaries should be increased to give supervision to the whole, then state secretaries (or by groups of states where the engineering population is scanty) and last, full time secretaries in the local chapters. There would be exceptions to this order due to local or regional development.

Employment Service

By E. B. Miller
Assistant Secretary in Charge of Employment Department

MORE THAN 1,800 men were placed in new positions by the service department of the American Association of Engineers during the year ending May 1, at an aggregate payroll of $4,000,000. Over 5,000 openings were received to which 17,000 members were referred. In April headquarters received 463 vacant positions to which 2,003 men were referred; of these 182 reported that they had obtained places. The cost was $6 per man reporting as placed in April. The offices at Pittsburgh, Washington, New York, Minneapolis, Chicago, El Paso, Los Angeles, Seattle and in Oregon handled 247 vacant positions and referred 400 men of which 118 obtained positions.

Standing Committee Reports

PRACTICE COMMITTEE—H. W. Clausen, chairman of the Practice Committee, stated that twelve former cases had been reported upon. Under the rules no names are given. The motto is to search for the truth, to correct wrongs and to educate the thoughtless.

A resolution was passed calling on engineers in public service to obtain written orders from their superiors when the performance of these orders would be contrary to the dictates of the conscience of the engineer. These orders are to be forwarded to the practice committee for action and publicity. If the engineer is unjustly discharged the official is to be condemned and the employment department will endeavor to locate the engineer elsewhere and will refuse to recommend other engineers to the same position.

The recommendation that the practice be condemned of suspending civil service employees in advance of preferment of charges, as has been done recently in Chicago, was concurred in.

Education—The committee on education, headed by Prof. Frederick Bass, University of Minnesota, outlined courses to be handled by chapters in evening classes. Use of the resources of nearby universities are suggested for technical review of engineering subjects. The evening class work suggested, and now being carried out in Chicago and a few other chapters, includes courses in American government, public speaking, banking, business law, public management, salesmanship and public utility operation.

Compensation—The municipal schedule proposed by the committee on salaries of engineers in public service was submitted by the chairman, A. N. Johnson, highway engineer, Portland Cement Association. It was adopted. (See *Engineering News-Record*, May 6, p. 898). On salaries of engineering educators, Prof. C. J. Tilden, Yale University, presented a progress report and a tentative schedule which has been sent out to the members of the committee.

Qualifications—The committee on qualifications, headed by W. H. Dean, assistant engineer, city engineer's office, Chicago, handled 19,864 applications last year. It is strongly against asking those clearly not qualified to bec[ome] members.

Employment—George C. D. Lenth, assistant chief en[gi]neer Sewers Board of Local Improvements, Chicago, cha[ir]man, recommended that the country be divided into four or five employment districts with offices in each district; that there be installed a card system, covering the personnel of the entire membership, similar to the cards used in the army; that a special charge be made for positions paying more than $2,400. The latter provision was voted upon unfavorably.

Chapter Activity—A debating society is the latest chapter activity undertaken in the Chicago chapter, stated W. J. H. Strong, chapter president. It grew out of the class in public speaking. Other activities taken up in a series of regular meetings are (1) economics for the engineer, (2) science for the engineer, and (3) self-help for the engineer.

F. K. Bennett, paid secretary of the Twin Cities chapter, stated that interest had been greatly augmened by a ladies auxiliary which provides monthly dinners and dances. The ladies keep the men informed as to meeting nights and urge attendance.

The Idaho chapter has induced half of its clubs in various cities to join the chambers of commerce. It will work through the latter in getting legislation for compensation or legislation for engineers. In turn the engineers will work for measures in which they are less personally interested.

Opportunities for American Engineers in Foreign Countries

By F. Lavis
Consulting Engineer, New York

BEFORE a nation can participate in the development of foreign enterprises it must develop among its own people a desire to buy the stocks and bonds of these enterprises. That desire hardly exists today in the United States. Fifty per cent of foreign engineering developments are likely to be connected with transportation.

In the construction of railways, especially in undeveloped or partly developed countries, I believe our engineers by virtue of their experience and training are pre-eminent. We know better, or at least we practice better, the art of adapting the railroad to its work than do European engineers.

Another important foreign field which American engineers are well able to take care of is that of the development of electric power. To say the least, we are, I believe, as well able to cope with these problems as the Europeans. In the development of oil fields and the construction of pipe lines our engineers are leaders. We are today directing the construction of a pipe line between Havre and Paris in France. The field of sanitation and municipal engineering is only beginning to open up. The principal cities of South America are fully alive to the need of good water supplies, sewerage and paving. The whole world is waking up to the changes brought about by the use of motor trucks and the need of good roads.

South and Central America and Mexico are attractive fields for us because they are our nearest neighbors and we know them. They need outside help for their development just as we needed it in the past. Besides money, which is the *sine qua non*, they need our technical skill and our organizing ability. The field there in almost every line of engineering endeavor is limited only by the amount of money we are willing to invest.

With the exception of Spain, the Balkans and Russia, we can pretty nearly entirely eliminate Europe from the field of possibilities abroad for American engineers. Russia and the Balkans will undoubtedly open up a field for our activities as soon as they are able to establish safe and sound governments. Before the revolution in Russia we were already investigating some very important transportation, coal and steel projects there, which were more or less linked up together, but these countries are off the map for the present.

Of all the European countries today, Spain presents the

most attractive field. Her material development is probably the most backward of any of the European countries except the Balkans, she has a good laboring population, large undeveloped natural resources, and since the beginning of the present century has been making remarkable progress toward economic prosperity, which has been greatly accelerated during the war.

There remain Asia, Africa and Australia. Both Africa and Australia are almost entirely dominated by European influences, largely by the British. The field for the American engineer in those continents is therefore quite limited.

The future of Siberia is inevitably linked up with the future of Russia. It is an enormous country with the characteristics of our great Northwest and Canada, and will open up some day, perhaps a little distant, a great field for American enterprise, particularly in connection with the construction of railways and the development of its great resources of mineral wealth. As in China, we shall be faced to some extent with the competition of the Japanese, but in this the question of investments will be the deciding factor.

Is the American engineer equipped to play his part in the development of foreign enterprises? Technically, I believe he is, but in many other ways he is not. I have felt for some time that our engineering schools for many years have been turning out merely technically educated engineers —men who are only to a certain degree a little better than skilled mechanics. Many of us have immediately gone from the schools out into the woods and lived the life of pioneers, disregarding and often disdaining the refinements of civilization. Engineers in foreign countries, men in official life, whether it be in Mexico, South America, China or elsewhere, are generally well educated, cultured persons. Perhaps some of them set too great a store by some of the refinements, even some of the ceremonies of older civilizations.

The engineer who goes abroad should be able to associate with the well educated eminent foreign engineers, with bankers, cabinet ministers, presidents and with kings with just the same right degree of cordiality as he does with a contractor, a drill runner or the driver of a team of mules. This *savoir faire*, this knowledge of how to meet any conditions of life will also do him no harm at home.

Engineers should not disdain a dress suit, frock coat, a silk hat or patent leather shoes, and should have the manners that go with them.

Engineers who wish to do something more than run a transit or figure the strains on a bridge, should have a fair knowledge of world politics, of world history. They should know what the main currents of commerce are and where they run, they must have a knowledge of business, of methods and customs of finance and not be afraid of knowing something of art and literature.

Engineering Publicity—Why and How

By Cedric B. Smith
Editor, Professional Engineering

A SIMPLE definition of engineering publicity is anything concerning engineers or engineering which is brought to the attention of the public. Publicity is nothing more nor less than advertising. What engineers have to sell is far more important to mankind than any one of a dozen things made as popular as kodaks and grape nuts have been by advertising. Services are to be sold. The better known the local body of engineers, the more force will the organization and individual have in politics.

Magazines, moving pictures and public speakers are available mediums of publicity, but the most common, easiest and most efficacious is the newspaper. The subject matter in magazines invariably follows the trend of current events. Current events are reflected most plainly in newspapers, hence if the latter contain engineering publicity, it follows that the magazines will also contain material concerning engineers and engineering. The word "engineer" appears in magazines of general circulation today at least several times more often than it appeared even one year ago. The *Saturday Evening Post* is running a series of articles written by an engineer. Where writers of fiction formerly made their hero a lawyer or a physician, they now incline toward an engineering hero with a virile background of engineering accomplishment.

What Is News?—The word news is one which is almost in universal use. One of us often says to another, "What Is the News?" in other words, What is new? When it comes to writing a formal definition of the word news, however, even experienced men find themselves in difficulty. In the issue of March 18, 1911, of *Collier's Weekly* there appeared a list of ten different definitions of news, submitted by as many newspaper editors. One said, "News is whatever your readers want to know." Another defines news as "anything that people will talk about; the more it will excite comment, the greater its value." "News is everything that happens," is the opinion of another editor. Possibly the best of all of these definitions is the following: "News comprises all current activities which are of general human interest and the best news is that which interests the most readers."

In efforts to obtain publicity search must be made for events which will appeal to the greatest number of readers. We must, if we are to deal in human relations, take cognizance of public opinion and be sensitive to popular interest. If the association is to serve the public well it must keep the public acquainted with its activities in behalf of the public. To acquaint the public the association must rely largely upon news. The special features which will appeal to the newspaper readers must be sought for and displayed as a means of acquainting the people with the efforts that are being made, even though these features may not be the most important from the engineer's standpoint. In addition to this, we must continually bend our efforts to educate newspaper editors to a better appreciation of engineering news.

Publicity in the form of news stories must of necessity be handled principally by local chapters and clubs on account of the fact that local news is in greater demand than national news of equal importance.

The Local Committee—Successful publicity accomplishment requires hard constant effort on the part of publicity committees. Give publicity committees full support and encouragement, and endeavor to have built up in the committee a tradition for getting all of the news while it is hot and getting it in print. The committee should meet often with the chairman to discuss publicity problems and means for accomplishing a greater amount of good for the chapter and the profession. At these meetings publicity methods can be discussed and different members of the committee assigned to different tasks. Their chairman should keep a "future" book exactly like that of the city editor of a newspaper. Possibly the city is expected to authorize the construction of a bridge. A member of the committee should be assigned to this subject exactly the same as a reporter is assigned to a story by the city editor of a newspaper. His connection with fellow members in the city engineer's office should get him in touch with sources of information which will give him the news even quicker than a reporter of one of the dailies. A man assigned to cover a meeting should send advance notice to the papers, and the story of the speaker or his subject. He should obtain advance copies of the address for the papers and finally see that the reporters who attend the meeting are supplied with full information or that an account is sent to each of the morning papers.

Publicity committees are the most important ones in the chapter. Fill them with capable, energetic men, selecting preferably those who have a liking for newspaper work, using young men for leg-work; that is, for gathering news, and the older, more experienced engineers for evolving publicity schemes and sketching out feature material. Urge members of the committee to become familiar with newspaper offices and newspaper practices. They should study the news stories in the papers each day, talk to reporters and become thoroughly acquainted with the elements of their task.

(*The Presidential address of L. K. Sherman appears on page 999 of this issue.*)

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Retaining Walls

REVIEWED BY EDWARD GODFREY
Pittsburgh, Pa.

RETAINING WALLS: THEIR DESIGN AND CONSTRUCTION —By George Paaswell, C. E. New York and London: McGraw-Hill Book. Cloth; 6 x 9 in.; pp. 275; 9 plates and 133 figures in the text. $4.

In his first three chapters the author deals with theories of earth pressures and of reinforced-concrete as applied to retaining walls. Various types of walls are next considered. Expansion joints and wall failures are emphasized in the fifth chapter. Plant and forms are very fully treated in two chapters. Concrete proportioning and placing are given much space. The rest of the book takes up other than concrete walls, surface treatment, waterproofing, drainage, field and office work, specifications, etc. A good bibliography is found at the end.

The author gives very practical problems that illustrate well his principles of design; also he gives some good practical suggestions that will aid the designer in keeping in view the fact that designs are made for execution in stone and steel and not as exercises in the working out of mathematical formulas. This is an excellent feature in an engineering work.

Much space is given up to "artist stuff" about the water ratio in concrete mixes and mixing concrete with brains instead of cement. This theory works out nicely in the laboratory, but on the job *cement* and *thorough mixing* produce better results than exponential formulas without them.

The author takes liberties with nomenclature that are exceedingly confusing—in fact intolerable. The letter k represents five different things on pp. 86, 24, 52, 96, and 152; p is different on pp. 87, 93, and 96; c is different on pp. 16, 17, and 22; d is different on pp. 89 and 91; q is different on pp. 65 and 89; g is different on pp. 27, 12, and 45. The last-named letter seems to mean the unit weight of earth, in most places, though an hour's search could not verify this. In Fig. 46 x is used for two different values. On p. 27 capitals and small letters are indiscriminately mixed in figure and text. The publishers should at once remedy this by issuing a sheet of errata, containing also a list of letters used and the pages where they have one meaning and where another.

The theoretical treatment of the fundamentals of earth pressure is admirable, chiefly because of what it omits. One admires the restraint of a man who knows all about the theory of the ellipse of stress and can omit it entirely in a book of this sort. The theory is simplified greatly—in fact, down to where the author almost shows that the whole thing can be discarded and instead the absurdly simple method can be substituted of using for all horizontal earth pressures an equivalent fluid pressure on the basis of an assumed fluid of a weight some fraction of the actual weight of earth. The writer has reviewed four books on this subject, and Mr. Paaswell is the first author to give even passing recognition of the equivalent fluid pressure.

The author acknowledges that many earths will stand a considerable time with no retaining wall. Theory defied. He tells, on p. 162, of walls that were "designed upon the assumption of a dry granular fill," and they failed. Standard theory discredited. Frost and rain are the great forces working against a retaining wall. Neither is amenable to theory. A simple theory of fluid pressure will take care of the effect of rain; anything more is ultra-theoretical. Frost is chiefly effective near the top of the wall and demands stability there that the theory does not touch upon. Mr. Paaswell does not recognize the place of either frost or rain in his theoretical treatment, though he does emphasize the importance of drainage elsewhere. This is standard but not safe.

The author discourages the use of a revetment wall by saying: "It is more of historic than of present interest" (p. 65). The revetment wall deserves a better place. An excellent example of the economy and efficiency of a stone revetment wall is to be found near the Union Station in Pittsburgh. There are many sloping and crumbling shale cuts where a revetment wall would be eminently in place.

Mr. Paaswell rejects the proposition that the counterfort of a reinforced-concrete retaining wall is merely the concrete covering for anchor rods tying the bottom slab and the vertical wall together. He says it is a triangular beam which is "standard." Nevertheless, he emphasizes again and again, in his example of a practical design, the importance of anchoring the wall and the slab *into the counterfort*. The latter is fully anchored twice, once by vertical rods and once by tension reinforcement of his triangular beam. *Then he designs a counterfort that could split in two and wreck the wall by merely cracking the concrete, without disturbing the steel.* (Fig. 51, p. 111). On p. 101 he refers to reasons given for treating the counterfort as a beam. The only reason for this that can be found is on p. 97—where "The counterfort will be treated as a cantilever beam." For the "depth" of the beam he uses a horizontal line, which, however, is diagonal to the steel. This is not correct. He makes the rods 1¼ in. in place of the required 1 in. merely to increase the grip. Steel is too precious for this. He should have added to the length at the upper end and saved the wall from possible collapse.

A proposition that would vitally affect design cannot be ignored, regardless of its author. It must have recognition, even if that recognition is to show why it is not true. Mere dismissal because in one's opinion it is not true is not sufficient.

Plain Talk on Inventions and Investors

INVENTIONS: THEIR DEVELOPMENT, PURCHASE AND SALE—By William E. Baff, Patent Attorney. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 230; $2 net.

Described as "essentially a manual on the marketing of inventions," the author also states that this book is intended "not alone for the ordinary layman without experience and worldly wisdom but for busy people in

every line desirous of understanding the nature of patent property in inventions." Although the author treats of various phases of his subject that might be expected to suggest the consultation of an engineer, he does not seem to recommend or even mention such action on the part of inventors, investors or manufacturers. The volume promises to be useful to the class of readers for whom it is designed. If widely read and profited by the book would lead to better and perhaps, but not necessarily, fewer patents, and would save inventors, investors and, last but not least, the public at large much loss.

How an Engineer Should Write

By P. B. McDonald
Assistant Professor of English, New York University, New York City

TECHNICAL WRITING—By T. A. Rickard, Editor of the *Mining and Scientific Press*, San Francisco; Formerly Editor of the *Engineering and Mining Journal*, New York, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 178. $1.50.

This is a better book than the author's "A Guide to Technical Writing," which was reviewed in the Engineering Literature section of *Engineering News*, Jan. 19, 1911. The present volume has grown from a series of five lectures delivered before the engineering classes of the University of California in 1916. It is designed especially to be of use to the engineer and the advanced college student. The style and method are that of the keen editor rather than that of the academic expounder. In the review of the earlier book in *Engineering News* fault was found with the emphasis which the author placed on diction and sentence structure, to the neglect of the psychology of thinking and writing—what some professors of rhetoric call synthesis and organization, or the composition as a whole. Mr. Rickard's point of view seems to be that, if the student can use words and construct his sentences properly, his arrangement of larger units depends upon common sense rather than on knowledge of a system.

Another objection in the review of 1911 was that the author cited himself as authority too freely. This objection is not so evident in the new book. While the author is not lacking in courage to trust his intuitions, he gives a number of excellent examples from Huxley, Ruskin, Sir Arthur Quiller-Couch, George M. Wood of the United States Geological Survey, Sir Clifford Allbutt, etc. Indeed, the book has quite a classical tone to it. Not only is the style more restrained and scholarly than in the "Guide to Technical Writing," but more important material is considered. There is a chapter on the relative pronouns, for instance, that brings out points that other rhetoricians have overlooked.

In the sentence "The engineers, who refused to submit, were discharged," the author points out that considerable difference arises in the meaning when the commas are omitted and the 'who' changed to 'that.' Many other excellent illustrative sentences are given, particularly in the interesting chapters on "Jargon" and "Slovenliness." The following extracts from the book are picked almost at random:

"Take note of the fact that nonsense remains nonsense however much you may disguise it in a veil of words. We think in words, and when we lack clear words we lack clear thoughts. . . . The following is a quotation from an address delivered by a prominent financier in San Francisco: 'Let us learn, then, to realize that each has his dominion and his empire of domination, in which by the exercise of these qualities that are alike in spelling success each may rise to a position of leadership, with potentialities of power as great in its sphere of action as that of the many, to whom we look for the time being, because of some particular preferment as a leader.' This is balderdash. It is the 'delirious trimmings' of language."

Of another confused sentence, this time from a technical journal, the author remarks that it reminds him of the following passage from 'Alice in Wonderland': "Never imagine yourself not to be otherwise than what it might appear to others that what you were or what you might have been was not otherwise than what you had been would have appeared to them to be otherwise."

The author cites Ruskin and Huxley for examples of commendable English. From Huxley, under whom he studied in the Royal School of Mines, he quotes from the 'lay sermon' on the formation of coal, that remarkable description of the prehistoric coal forests in which "stupid, salamander-like Labyrinthodonts pottered, with much belly and little legs, like Falstaff in his old age." One of the passages quoted from Ruskin is his artistic delineation of the district between Valorsine and Martigny. Mr. Rickard says: "This 'play of human speech' is so exquisite that it is safe to infer the toil of the true artist. Note the imagery: the paths like 'winding stairs'; the rounded rocks like 'plunging dolphins'—the porpoises of unpoetic fact; 'the crest of corn upon the rock casque'; the meadows 'like inlets of lake among the harvested rocks.'"

Of Mr. Rickard's own style, it can be said that he prefers short, pithy sentences, self-conscious almost in the French manner. His phrases scintillate sharply and pique the reader to continue. Some critics will consider that he splits to many puristic hairs, but the careful student will find a world of valuable suggestions compact in this little work. The author has been quick to see the scientific, scholarly, and practical.

New Viewpoints of City Planning

WHAT OF THE CITY?: America's Greatest Issue—City Planning What it is and How to go About it to Achieve Success—By Walter D. Moody, Managing Director, Chicago Plan Commission. Author of "Wacker's Manual of the Plan of Chicago," etc. Chicago, Ill.: A. C. McClurg & Co. Cloth; 5 x 8 in., pp. 441; illustrated. $2.50.

The chief value of this informing and inspiring book lies in its story of Chicago's leadership in city planning and in executing the notable plans that have been made. Interspersed with this story are some good observations on city planning in general and a mass of information and assertion about the greatness and the mere bigness of Chicago that must be wearisome to almost every reader outside Chicago as well as to modest and cultured people in the windy city itself.

Aside from his lively story of the origin and progress of city planning in Chicago—or perhaps one should say as a part of that story—the author's most distinctive contribution to city planning literature is his explanation and advocacy of what in the commercial parlance of the day is called the "salesmanship" of city planning. As the author well says, two hundred cities have gone more or less extensively into city planning—officially in some cases but more generally through the efforts of private citizens, civic or commercial organizations—but in only ten or twelve instances have the plans got far, if any, beyond the paper stage. Chicago leads not only in fullness and boldness of conception but also in the degree of execution. This

leadership has come from the late David H. Burnham on the artistic and technical side and from Charles H. Wacker, chairman of the Chicago Plan Commission, on the broad promotional side, while the author has been an exponent of the "salesmanship" idea. Steadily back of all that has been accomplished has been the Chicago Commercial Club and other local organizations and the Chicago Plan Commission. It is noteworthy that Commercial Club members have subscribed $303,600 to promoting the Plan of Chicago against only $99,190 appropriated by the city of Chicago—but the millions upon millions of bonds voted by the people of Chicago to carry out the plan should not be overlooked. Worthy of mention, also, is the fact that the Chicago Plan Commission has a total membership of 328. Just how the commission functions with the city authorities the author might well have explained. The inference is that the commission is simply a body advisory to the City Council and promotional with the mass of the people and with their leaders in various organizations. Remarkable educational work has been done through the public schools.

The author truly says: "Rarely in America is city planning initiated by the municipal government." The movement must be started and at least the early stages of specific planning must be financed privately—as distinguished from official municipal action. The same is also true of the promotional work. In fact, so little confidence has the author in either initiation or the continuous prosecution of city planning by the city itself that he comes out strongly for endowment. That this should be the conclusion of one so intimately associated with Chicago's great achievement affords a subject for reflection. It seems almost an indictment not merely of municipal government but of democracy. But it is not quite fair to the author to question his conclusion when set forth almost wholly detached from his context. Therefore we feel all the more justified in commending the book to the attention of all close students of municipal affairs.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings, 1919—Chicago, Ill.: C. A. Lichty, Secretary. Cloth; 6 x 9 in.; pp. 176. $1.

CONNECTICUT PUBLIC UTILITIES COMMISSION: Report, 1918-19—Hartford, Conn.: The Commission. Cloth; 6 x 9 in.; pp. 811.

THE DETERIORATION OF STRUCTURES OF TIMBER, METAL AND CONCRETE EXPOSED TO THE ACTION OF SEA-WATER: First Report of the Committee of The Institution of Civil Engineers—Edited by P. M. Crosthwaite, B. A. I., M. Inst. C. E., Secretary to the Committee and Gilbert R. Redgrave, Assoc. Inst. C. E. London, Eng.: H. M. Stationery, Imperial House, Kingsway. Cloth; 6 x 9 in.; pp. 301; illustrated. 30s.

EDUCATION AND TRAINING FOR THE ELECTRICAL AND ALLIED ENGINEERING INDUSTRIES: Report of Education Committee of the British Electrical and Allied Manufacturers' Association (Incorp.), New York: Longmans, Green & Co., London; Edward Arnold. Cloth; 5 x 8 in.; pp. 64.

FLORIDA ENGINEERING SOCIETY: Year Book, 1920—Gainesville, Fla.: Secy., J. R. Benton. Paper; 6 x 9 in.; pp. 45; illustrated. 25c.

FURTHER INCIDENTS IN THE LIFE OF A MINING ENGINEER—By E. T. McCarthy, A. R. S. M., M. I. M. & M., M. I. M. E., M. Am. I. M. E., F. R. G. S. New York: E. P. Dutton & Co., London: George Routledge and Sons, Ltd. Cloth; 6 x 9 in.; pp. 400. $7.

HOME BUILDING FOR WAGE EARNERS: A Financial and Economic Problem—New York: Fred T. Ley & Co., Inc. Paper; 6 x 9 in.; pp. 55; illustrated.

An instructive exposition of the details of industrial housing written mainly for the company whose employees need homes by Leslie H. Allen.

THE HOUSING PROBLEM: Its History, Growth, Legislation and Procedure—By John J. Clarke, M. A., F. S. S., Accountant of The University of Liverpool; Lundie Medallist for Citizenship, etc.; with an Introduction by Brig.-General G. Kyffin-Taylor, C. B. E., V. D. New York and London: Sir Isaac Pitman & Sons, Ltd. Cloth; 6 x 9 in.; pp. 544. 21s net.

HOW TO USE CEMENT FOR CONCRETE CONSTRUCTION FOR TOWN AND FARM: Including Formulas, Drawings and Specific Instruction to Enable the Reader to Construct Farm and Town Equipment—By H. Colin Campbell, C. E., Director Editorial and Advertising Bureau Portland Cement Association, Contributing Editor to Numerous Farm, Trade and Technical Periodicals. Chicago, Ill.: Stanton & Van Vliet Co. Cloth; 5 x 8 in.; pp. 380; illustrated. $2.

A popular text mostly for the amateur. Worth while for the prospective user of home-made concrete.

INTERNAL-COMBUSTION ENGINES: Their Principles and Application to Automobile, Aircraft, and Marine Purposes—By Wallace L. Lind, Lieutenant Commander, United States Navy, M. S. (Columbia University) New York and London: Ginn and Co. Cloth; 6 x 9 in.; pp. 225; illustrated. $2.20.

For the average student. There is a chapter on the Thermal Properties of Gases, and the Principal Ideal Cycles Applicable to Internal-Combustion Engines.

INTERNATIONAL WATERWAYS: I—The Evolution of the Principle of International Waterways; II—A Reference-Manual to the Treaties, Conventions, Laws, and other Fundamental Acts Governing the International Use of Inland Waterways—By Paul Morgan Ogilvie, M. A. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 424. $3.

Historical résumé of the part that waterways and particularly boundary waterways has played in commercial development in the world, together with a reference manual listing all of the international conventions or treaties relating to boundary waters. "The purpose of this reference manual is to provide a facile means of determining the law governing navigation of any specific waterway."

INVESTIGATION OF THE COMPRESSIVE STRENGTH OF SPRUCE STRUTS OF RECTANGULAR CROSS SECTION AND THE DERIVATION OF FORMULAS SUITABLE FOR USE IN AIRPLANE DESIGN—By James E. Boyd, Professor of Mechanics, Ohio State University; Expert on Aviation Problems at Bureau of Standards, Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 43; illustrated. 10c. from Superintendent of Documents.

MASSACHUSETTS COMMISSION ON WATERWAYS AND PUBLIC LANDS: Report, 1913—Springfield, Mass.: The Commission. Cloth; 6 x 9 in.; pp. 99; folding map.

THE MISSISSIPPI RIVER COMMISSION: From Annual Report Chief of Engineers, 1919—Washington, D. C.: War Department. Paper; 6 x 9 in.; pp. 1813; illustrated.

THE NEW INDUSTRIAL UNREST: Reasons and Remedies—By Ray Stannard Baker, Garden City, N. Y.: Doubleday, Page & Co. Cloth; 6 x 9 in.; pp. 231. $2.

NEW SOUTH WALES DEPARTMENT OF PUBLIC WORKS: Report, 1918-19—Sydney, Australia: The Department. Paper; 8 x 13 in.; pp. 91; illustrated.

OPPORTUNITIES IN ENGINEERING—By Charles M. Horton. New York and London: Harper & Brothers. Cloth; 5 x 8 in.; pp. 90. $1.

ORGANIZED LABOR IN AMERICAN HISTORY—By Frank Tracy Carlton, Ph. D., Professor of Economics, De Pauw University. New York and London: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 313. $2.50.

PIEUX ET SONNETTES—Par Edouard Noe et Louis Troch, Ingenieurs. Paris: Gauthier-Villars Et Cie. Paper; 7 x 10 in.; pp. 348; illustrated. 20 francs.

SELECTED ARTICLES ON PROBLEMS OF LABOR—Compiled and Edited by Daniel Bloomfield with an Introduction by Meyer Bloomfield. New York: The H. W. Wilson Co. Cloth; 6 x 9 in.; pp. 436. $1.80.

Not the "labor problem" but "problems of labor," as is pointed out in the Introduction, is the subject of this compilation. Some of the main heads under which the selections fall are: Causes of Friction and Unrest, Cost of Living, Profit Sharing, The Shorter Work-Day, Trade Unionism, Labor Disputes and Adjustment, Housing, and Industrial Hygiene.

THE SUPERVISION OF PUBLIC WATER SUPPLIES BY THE NEW YORK STATE DEPARTMENT OF HEALTH—By Theodore Horton, C. E. Reprinted from Journal of the New England Water Works Association, Vol. XXXIII, No. 4. Boston, Mass.; The Association. Paper; 6 x 9 in.; pp. 8.

TECHNICAL WRITING—By T. A. Rickard, Editor of the "Mining and Scientific Press" San Francisco; Formerly Editor of the "Engineering and Mining Journal." New York, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 178. $1.50.

THE WESTINGHOUSE E-T AIR BRAKE INSTRUCTION POCKET BOOK: A Complete Work Explaining in Detail the Improved Westinghouse Locomotive Air Brake Equipment, Including both the No. 5 and the Standard No. 6 Styles, with Recent Modifications—By W. W. Wood, Air Brake Instructor, Author of "The Walschaert Locomotive Valve Gear," "Locomotive Breakdowns," etc. Second Edition—Revised. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 7 in.; pp. 258; illustrated with colored plates. $2.50.

A detailed instruction book on the latest forms of improved "E-T" air brake equipment, with changes in practice made necessary by higher speeds and heavier rolling stock. Contains color diagrams of air equipment, including the modern distributing valve. Also contains detailed directions for operation and maintenance and enginemen's examination questions and answers. The first edition was noticed in *Engineering News*, June 17, 1909.

LETTERS TO THE EDITOR

Suggested Remedies for Some Ills of the Engineer

Sir—Referring to the discussion on the improvement of the status of engineers in society, it is my opinion that Mr. Swaab's article, in your issue of March 4, p. 482, hits the vital spot. The fact that lawyers and physicians are as a rule in business for themselves is the main reason for their dignity. Since they are, as a body, established on every hand in all communities, their signs hung out and the public obliged to go to them, they thus obtain a large amount of advertising. Also, their independence makes them broader men, since they are free to assert their own individuality and since success depends entirely on themselves.

When a client engages a lawyer or physician, he does not make a bargain as to the fee—the client merely decides what quality of lawyer he wants according to the importance of the case, and after the work is done the lawyer submits his bill in amount to suit himself.

If, by some united action, engineers should break away from existing custom and take their profession into their own hands, engaging recent graduates as assistants, then would the tables be turned and the capitalists, promoters, municipalities, etc., would come to them for advice at such prices as they (the engineers) might elect. This would require that engineers be broader and better able to handle all phases of at least one subdivision of engineering. The practice of some corporations of subdividing work so that engineers are made to specialize on one detail, and become proficient in that only, tends to split the profession into a large number of routine workers.

It is, of course, true that lawyers and physicians necessarily come into direct contact with people from all walks of life, and are thereby more universally recognized, whereas engineers' dealings are usually confined to a limited class of society.

H. W. KENNEY.

Washington, D. C.

Shall Chinese Labor Be Imported?

Sir—I noticed in the *Engineering News-Record* of May 6, p. 926, a letter from John Ericson, former city engineer of Chicago, offering a solution for the shortage in unskilled labor. Mr. Ericson was kind enough to send me a copy of this same letter under date of April 27, to which I replied on May 1. I am inclosing you copy of my reply to Mr. Ericson, thinking that it may interest you.

EDWARD E. WALL,
Water Commissioner.

St. Louis.

[Copy of Mr. Wall's letter to Mr. Ericson follows.—EDITOR.]

May 1st, 1920.

I received your communication of April 27 yesterday and, while I agree with you that shortage of unskilled labor is a very serious problem at the present time, I am unable to bring myself to the belief that your suggested remedy, namely, that of the restricted importation of Chinese laborers, would either be a wise thing to do or would result in the solution of the problem.

In the first place, you will find the entire population of the Pacific coast opposed to this proposition to the absolute point of rebellion. Next, I believe you would find the entire body of organized labor in opposition to such a measure. In my opinion the importation of Chinese labor would make a bad matter worse. The importation of these laborers would still further intensify the division of all labor into classes, which, in my opinion, is one of the evils which have helped to bring about our present difficulties.

I believe that a step towards the solution of our problems lies in getting more work, both in quantity and variety, from the individual. The efforts of labor organizations for many years have been directed toward the division of labor into an infinite number of areas, which may be considered as bounded by circles touching each other but not intersecting or over-lapping. At the present time their efforts have apparently reached the climax of success, and we have the condition in which each mechanic, artisan and laborer performs only the task allotted to his little restricted circle.

For example, the carpenter will now do nothing but saw, plane and fit boards and nail them together. He will not handle his own lumber nor wait upon himself, but has to have a helper to do his menial tasks. This is the case with all classes and conditions of labor; consequently, no man is doing the full amount of work of which he is capable during the eight hours to which he has limited his working time each day.

It should be evident, it seems to me, that production must be greatly restricted under such methods of industry. We should get back to the time when workmen of all classes took pride in the work that they turned out and did not hesitate to turn their hand to any task that was connected with or incidental to the job.

Another thing that has largely contributed to bringing about the serious condition of affairs in this republic is the facility which has been afforded the labor organizations for adding increase upon increase to the prices demanded for their services. This has resulted in enticing the laborers from the agricultural districts into the smaller towns, from thence into the larger towns and finally into the large cities, causing great congestion of population and consequent scarcity of housing, forcing up the price of all commodities, followed by increases in wages and so on ad infinitum.

The only possible remedy for this condition of affairs is to force up the prices of farm products until farming becomes far more profitable than the returns paid to mechanics and laborers generally. Either this or a very substantial reduction in the wages paid mechanics and laborers, so that the present prices of farm products will induce men to go back to agricultural pursuits.

In my opinion, this country of ours must come back to sane methods of thinking. It may be possible that this present condition is simply a wild dissipation in which we are all indulging and a little later on we will get over this intoxication and will come back to earth again. In short, my idea of a solution of our troubles is that we must speed up production by making our labor more efficient and inducing our population to become more economical.

Approximate Rules for Strength of I-Beams

Sir—On page 686 of your issue of April 1, 1920, Edgar Piercy criticizes the approximate methods for quickly determining the strength of I-beams submitted by W. H. Cullers and the writer on page 388 of your issue of Aug. 21, 1919. By reference to the Aug. 21, 1919, issue, it will be seen that the writer suggested "another very simple way of arriving at the approximate section moduli of I-beams," as a commentary on the article appearing in your issue of July 17, 1919, page 115, by Manton E. Hibbs. Both the text and table in Mr. Hibbs' article make it clear that the entire reference is to *standard* I-beams. The method proposed by the writer, of multiplying the depth by the weight per foot and dividing by 10, was intended to apply only to such beams as were covered by Mr. Hibbs' article.

Mr. Piercy has made the error of assuming that the method had a universal application. This would be manifestly illogical, inasmuch as the heavier beam sections of a given depth are in general composed of a standard I-beam plus a rectangle of steel, the full depth of the beam. The approximate formula for the section modulus of a standard beam is $wh/10$ whereas the formula for section modulus of a rectangular steel beam is $wh/20.4$, from which it will be seen that a pound of standard I-beam is twice as valuable in bending as a pound of extra-weight web.

Ready rules such as those suggested are a great convenience, particularly on rush work, field operations, rough checking of work already in position, etc. It should be noted that the vast majority of I-beams used are of standard weight and ordinarily these are the ones available from stock.

G. S. BURRELL.

Charleston, S. C.

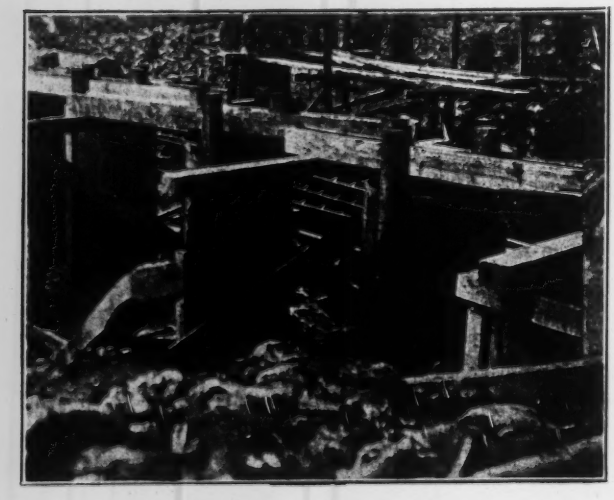
HINTS FOR THE CONTRACTOR

Collapsible Forms Used in Pouring Walls of Deep Circular Pits

RECENTLY there were constructed in Detroit about 100 30-in. diameter pits approximately 20 ft. deep, below the basement floor of a new building, to take the travel of a press plunger. They were lined with 6 in. of concrete and a 12-in. mat placed in the bottom. The holes to be excavated were therefore 42 in. in diameter. As the material on the site was stiff, blue clay, no sheathing of any kind was necessary. The excavation was handled by a small caisson bucket raised and lowered by means of a small derrick equipped with hoisting engine. The buckets were small enough to enable a man in the hole to fill them and the derrick could be moved easily from one line of holes to another. Two men, one in the hole and one on top could excavate to the required depth in from two to three days.

The form used had to be collapsible so that it could be removed from the top as there was not enough room for a man to go down inside to strip it. A cylindrical form the full depth of the hole was made in four longitudinal sections. Between each two sections, a 4-in. x 4-in. timber was fitted as a key, the side against the concrete being dressed to 3 in. The four timbers, 4 in. x 4 in., extended about one foot beyond one end of the form, so that the form could be suspended in the hole. The other end of the form had a wooden bottom with a 1-in. hole drilled through the center, into which fitted an iron pin driven on center in the clay at the bottom of the hole and projecting up about 16 in. The 4-in. x 4-in. pieces were not fastened in any way but were kept spread by 2-in. x 4-in. struts not nailed, and spaced about 4 ft. apart. The side of the form was made of 1-in. x 6-in. boards nailed to 2-in. x 4-in. templates about 12 in. apart.

To assemble these forms, a cradle was used to hold the sections while column clamps were put around and tightened. Then a few turns of wire were made around the forms but not fastened to it, and then the clamps were removed before lowering forms into the hole. The forms were well smeared up with crude oil just before being placed. They were stripped on the day after concrete was poured by knocking down from the top the struts holding the 4 x 4's and then knocking the 4 x 4's toward the center of the hole. Each longitudinal section was then easily removed.



Wire mesh was used for reinforcement and dropped into hole after form was placed. The form was hung from the top and braced carefully to resist upward pressure of concrete.

Concrete Plug and Grout Injection Close Tunnel Leak

COMPLETE closure of a leak amounting to 1,000,000 gal. a day under 500 lb. pressure, which developed from a rock fissure crossing a raise being driven in the mine workings of Modderfontein East, Ltd., South Africa, was effected at small expense by constructing a concrete plug or dam and by subsequent grout injection. As described by Thomas Blanchford in the January, 1920, *Journal of the South African Institution of Engineers*, the work to effect closure was carried out substantially as follows:

A 1:1:2 stone concrete was rammed into the face to a thickness of approximately 4 ft. No hitches for support were cut in the rock, but forty 1-in. steel pegs were driven into the rock in two rows around the perimeter of the drive so as to project a distance of about 1 ft. 6 in. into the mass concrete. In addition to this, two rows of ½-in. bars, one vertical and one horizontal, the bars being also about 1 ft. apart, were embedded in the concrete during construction and tied by means of wire to the pegs, thereby forming a double grille system of reinforcement.

The water was confined behind the concrete to as small a channel as possible with the aid of 21-gage steel sheets, and released through two 6-in. pipes fitted with stop valves. By this means it was possible to place the concrete in position without interference from the water. Six 1½-in. cementation pipes were also built in the dam for the purpose of filling and solidifying the fissure and for the subsequent testing of the ground in advance. While this work was in progress three release holes were drilled into the hanging wall from the front of the dam at an angle of 45 deg., thereby intersecting the fissure approximately 12 ft. above the hanging of the raise, water being tapped in each of these holes.

The work of construction of the dam occupied two days, after which it was allowed to set for 3 days. During this period the water was flowing freely from the 6-in. drain pipes.

A total of 4 tons 14 cwt. (about 25 bbl.) of cement were required for the dam. Injection was then started and 25 tons 9 cwt. (about 170 bbl.) of cement was injected at pressures of from 25 lb. to 220 lb. The total time of construction was 14 days and the total cost was about £398 or less than $2,000.

NEWS OF THE WEEK

New York, May 20, 1920

Engineer Delegates Named for Organizing Conference

Returns on May 15 Indicate 90,000 Engineers Will Be Represented at Washington Meeting

At least 100 delegates, representing a membership of more than 90,000 engineers, will attend the Organizing Conference of technical societies to be held in Washington, D. C., June 3 and 4, according to a statment given out May 15 by the Joint Conference Committee, which has just announced a tentative program for the meeting to consider the formation of a country-wide federation of national, state and regional engineering bodies. Thirty-one societies, on May 15, had advised the committee that delegates had been named or would be appointed forthwith. Among them are the following:

American Society of Civil Engineers.
American Institute of Mining and Metallurgical Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
American Society for Testing Materials.
American Electric Railway Engineering Association.
American Association of Petroleum Geologists.
American Ceramic Society.
American Society of Safety Engineers.
American Association of Engineers.
Cleveland Engineering Society.
Engineers Club of Philadelphia.
Florida Engineering Society.
Illinois Society of Engineers.
Kansas Engineering Society.
Mohawk Valley Engineers' Club.
Portland (Ore.) Technical Council
Trenton Engineers Club.
Vermont Society of Engineers.
Washington Society of Engineers.

The committee urges all engineering societies to be represented and to participate in the deliberations of the Conference, which, the committee believes will be "one of the most important gatherings that has been held in the history of the engineering profession in this country."

Richard L. Humphrey, chairman of the Joint Conference Committee, will call the Conference to order at 10 a.m., June 3, in the New Willard Hotel. Following the election of a temporary chairman and the appointment of committees there will be fifteen-minute addresses on the general subject of the engineer in public affairs by Arthur P. Davis, president, Am. Soc. C. E.; Philip N. Moore, past-president, A. I. M. E.; William F. Durand, chairman, San Francisco Section, A. S. M. E.; and Le Roy K. Sherman, president, A. A. E.

At a round-table luncheon, June 3, James H. McGraw, president, McGraw-Hill Co., Inc., will speak on "The Value of Publicity for Engineers." The afternoon session will be devoted to committee reports and ten-minute discussions on licensing of engineers by T. L. Condron, F. H. Snow and D. W. Brunton. The topic of good roads has

(*Continued on p. 1032*)

Governor Signs New York Engineers Licensing Bill

The bill for the licensing of engineers and land surveyors in New York State was signed by the Governor May 14 and is now a law, although its requirements do not become effective until a period of two years has elapsed. The measure was initiated by joint action of the New York Chapter of the American Association of Engineers and the Albany Society of Civil Engineers and was endorsed at a recent meeting of the newly formed New York Section of the American Society of Civil Engineers.

The new act requires a license for any person "practising or offering to practice professional engineering or land surveying." A state board of licensing consisting of five members, who have been engaged in the practice of engineering for at least 10 years and in responsible charge of work 5 years, is created. They will receive compensation for attending board meetings in addition to traveling and clerical expenses. Two regular meetings yearly and special meetings when desirable are provided for. The licensing fee to be paid is fixed at $35.

Minimum Requirements

The minimum requirements for candidates applying for licenses as professional engineers are as follows: Age, 21 years; professional practice, 4 years, of which 1 year shall have been "in responsible charge as assistant." No citizenship requirement is stipulated. Land surveyors, however, must be citizens and have had 3 years' experience, 2 years in an engineering school being considered equal to 1 year of practice.

Unless disqualifying evidence be before the board, the following facts established in the application "shall be regarded as prima facie evidence, satisfactory to the board, that the applicant is fully qualified to practice professional engineering or land surveying.

"(a) Six or more years of active engagement in professional engineering work, one of which shall have been in responsible charge of work, or in the case of applicants for license as a land surveyor, four or more years of active engagament in land surveying work of a character satisfactory to the board;

"(b) Graduation, after a course of not less than four years in engineering from a school or college approved by the regents as of satisfactory standing, and an additional four years of active engagement in professional engineering, one of which shall have been in responsible charge of work, or two years of active engagement in professional land surveying of a character satisfactory to the board."

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A. A. E. Convention Favors Decentralization Plan

Chapters to Be More Active—Delegates Will Attend Organizing Conference —Group Insurance Considered

A distinct desire for decentralization of routine work and evidence of a wide-awake constituency were clearly shown at the St. Louis convention May 10 and 11 of the American Association of Engineers. The practical effects of this attitude were expressed by an unwillingness to vote for any increase in dues or entrance fees, and by a demand for the doing of more work by the chapters. Only twice was the roll call by chapters demanded — once on the question of increasing dues to $12, and once to $15. The latter proposal was lost by a vote of 5,702 to 2,835. With few exceptions all of the twenty proposed amendments to the constitution and by-laws were defeated and the sane procedure of leaving the work to a committee prevailed. It was felt that the organization is growing too fast to redraft a suitable constitution until the conditions to be met are better known and the society is more stable.

D. L. Turner, chief engineer, Transit Construction Commission, New York, clarified the situation, after a day's parliamentary debate, much lobbying and cloak-room discussion, by proposing a letter ballot, carried on by the chapters, on such necessary legislation as the board of directors felt essential to meet emergencies. A letter ballot to individuals handled entirely by headquarters costs more than $1,000, but chapters can canvass their members at a much lower cost. Provision for so doing and for delegate representation at conventions instead of the town-meeting plan were the only amendments passed.

Group Insurance Plan

As reported briefly last week, the appointment of a committee to consider the creation of a group-insurance, home-building and owning company as an auxiliary, entirely separate from the association financially, was authorized. The 21-story City Hall Square Building in Chicago, which has been appraised recently at 95 cents per cubic foot, has been offered at about one-half that figure. A committee headed by Harold Almert, consulting engineer, Chicago, is looking into the proposal, which requires an initial payment of $216,000. The building would be used as the legal reserve back of a group insurance plan. The purpose of the enterprise is to stabilize the organization.

Without qualifications the statement of the national board of directors (see

Engineering News-Record, Nov. 13-20, 1919, p. 903) on the attitude toward labor unionism, as applied to engineers, was endorsed and the statement added that the advocacy by a member of A. A. E. of strikes or other methods commonly employed by labor unions to secure their ends be considered a sufficient ground for his expulsion. Greater individual application and industry was approved as a manifest duty of every member.

Last year's decision to stay out of Canada was rescinded. A special committee was authorized to canvass fully the question of admitting non-citizens to membership, the relations to foreign engineers, engineering societies of recognized standing and the establishment of chapters in foreign lands.

Attitude on Organizing Conference

The question of participation in the Organizing Conference in Washington, D. C., as noted last week, was explained by Prof. F. H. Newell and not followed by discussion, the convention apparently acquiescing in the action of the board of directors in its decision to be represented by delegates to be chosen by the out-going and in-coming presidents. The financial part of the unity plan recently promulgated, whereby members of 122 engineering societies might become members of the A. A. E. under a reduced entrance fee of $5, was not approved, the convention being of the opinion that any arrangements must be reciprocal.

Several resolutions on general subjects were approved, such as state and federal highway programs; aircraft development; adoption and strict enforcement of civil laws; civil service laws to allow non-resident candidates equal privileges with resident candidates, for the purpose of bringing in new blood, new methods and ideas; engineers to fill city managers' positions; engineers or architects for building commissioners; endorsement of qualified engineers seeking public office; reservation of Alaskan timber for the manufacture of paper; prohibition of export of such natural products as petroleum, wood and wood pulp or paper. Questions to be asked of each presidential candidate related to his attitude on the proposed national department of public works; appointment of an engineer to the Interstate Commerce Commission; conservation and development of natural resources; budget system; reclamation of waste lands by drainage, irrigation, flood control or other methods.

Results of the election, in which 4,682 ballots were cast, only 34 being invalid, gave L. K. Sherman, president, U. S. Housing Corporation, for president, 4,616 votes; H. O. Garman, chief engineer, Indiana Public Service Commission, for first vice-president, 2,770 votes; A. B. McDaniel, principal engineer, Construction Division of the Army, 1,962 votes for second vice-president. The six new directors are Edmund T. Perkins, consulting engineer; Prof. Frederic Bass, University of Minnesota; R. W. Barnes, first assistant engineer, Southern Pacific Ry. Co., Portland, Ore.; W. C. Bolin, pilot engineer, valuation department, Baltimore & Ohio R.R., Chicago; B. A. Bertenshaw, valuation engineer, Cleveland, Cincinnati, Chicago & St. Louis R.R., Cincinnati; Charles A. Finley, managing engineer, Bureau of Water, Pittsburgh. Of the 11,300 certified and 2,000 junior members eligible to vote 33 per cent exercised their franchise. The new board of directors elected the following to the executive committee: L. K. Sherman, Ray Burnham, A. N. Johnson, E. T. Perkins and H. O. Garman.

Buffalo was chosen as the place for the next year's convention.

New York License Bill

(*Continued from p. 1031*)

Licenses are to be granted by majority vote of the board.

The following exemptions are provided for by the act:

"1. Offering to practice in this state as a professional engineer or land surveyor by any person not a resident of and having no established place of business in this state.

"2. Practice as a professional engineer or land surveyor in this state by any person not a resident in this state and having no established place of business in this state, provided that said person is legally qualified for such professional service in his own state or country where the necessary qualifications for which in said state or country meet the requirements of the board of regents.

"3. Practice as a professional engineer or land surveyor in this state by any person not a resident of and having no established place of business in this state, or any person resident in this state, but whose arrival in the state is recent; provided, however, such a person shall have filed an application for license as a professional engineer or land surveyor, and shall have paid the fee provided for in section thirty-nine of this act. Such exemption shall continue for only such reasonable time as the board requires in which to consider and grant or deny the said application for license.

"4. Engaging in professional engineering or land surveying as an employee of a licensed professional engineer or a licensed land surveyor, or as an employee of a professional engineer or land surveyor authorized by paragraphs two and three of this section, provided that said practice may not include responsible charge of design or supervision as principal.

"5. Practice of professional engineering or land surveying solely as an officer or as an employee of the United States.

"6. Practice of professional engineering or land surveying solely as an employee of this state or any political subdivision thereof, at the time this act becomes effective and thereafter only until the expiration of the then existing term of office of such employee."

It is stipulated that two years after this act goes into effect, no county, city, town or village or other political subdivision in the state shall engage in the construction or maintenance of any public work costing more than $2,000 and involving professional engineering or land surveying of which plans, specifications and estimates have not been made by, and the construction and maintenance supervised by a licensed, professional engineer or land surveyor.

Hearing on Increase of Niagara Power

A hearing on the proposed increase in diversion of water at Niagara Falls will be held at the Chamber of Commerce Building at Niagara Falls, N. Y., on June 3, 1920, at 2:30 p.m., city time. According to the notice sent out by Col. J. G. Warren, Corps of Engineers, U. S. A., the hearing is "upon the subject matter of a report upon an investigation of the diversion of water from the Great Lakes and Niagara River, N. Y., by the Division Engineer, Lakes Division, in accordance with Joint Resolution approved June 30, 1917, authorizing and directing the Secretary of War to 'Make a comprehensive and thorough investigation, including all necessary surveys and maps, of the entire subject of water diversion from the Great Lakes and Niagara River, including navigation, sanitary and power purposes, and the preservation of the scenic beauty of Niagara Falls and the rapids at Niagara River, and to report to Congress thereon at the earliest practicable date.'"

The report may be seen by interested parties, prior to the hearing, at which they are invited to be present, at the office of the Board of Engineers for Rivers and Harbors, 735 Southern Building, Washington, D. C., and at the office of the Division Engineer, 537 Federal Building, Buffalo, N. Y.

Organizing Conference

(*Continued from p. 1031*)

been assigned to Thomas H. MacDonald and W. D. Uhler. In the evening Homer L. Ferguson, past-president of the U. S. Chamber of Commerce, will talk on "Co-operation of the Business Man and the Engineer in Public Affairs."

A business session will occupy the morning of June 4. Prof. F. H. Newell will be the speaker at luncheon, while in the afternoon, at the Cosmos Club, the general subject will be co-operation of engineers in local affairs. A number of addresses are on the program for the evening session. The speakers include Robert S. Woodward, president, Carnegie Institute; George Otis Smith, director, U. S. Geological Survey; and James R. Angell, chairman, National Research Council.

Highway Council Urges Road Plank in Party Platforms

Members of the Federal Highway Council are receiving circular letters from that organization requesting all possible assistance in its efforts to have incorporated as a plank in the party platforms of the Republican and Democratic parties the creation of a Federal highway commission of five members, the establishment of a national system of highways, the continuance of Federal-aid after 1921, and the expenditure, in so far as possible, of Federal appropriations so as to provide definite systems of connected highways—national, state and county.

Commission of Five Members

The plan contemplated by the Federal Highway Council is the creation of a commission of five members, selected geographically, with authority to take over the present highway activities of the Department of Agriculture in cooperation with the states, and the expenditure of present and future appropriations of Federal-aid. Instead, therefore, of such works being handled by one of sixteen bureaus of a governmental department, the responsibility will be placed in a separate body, the sole duty of which will be the study and administration of highway affairs. The proposed plan further includes the division of the United States into five districts, giving each district one commissioner. Each commissioner will personally study conditions for highway development in his own district and, having direct authority, will support and strengthen the efforts of the district highway engineers representing the Federal government, now located throughout the country. The proposed national system is to consist of sufficient mileage to provide two roads across each state, and, where practicable, one running east and west and one north and south, and connecting with similar roads in adjoining states. The continuance of Federal aid until after 1921 is deemed advisable until such time as the states will be able to complete their state systems as a part of a definite systematic plan of highway development.

National System Mileage

The Federal Highway Council believes that the Federal Governmtnt should take over approximately 60,000 mi. of the main highways, to construct and rebuild, where necessary, as a national system. It also believes that the states should take over approximately 240,000 mi. of the main state system, and the counties an additional 300,000 mi. of market county roads. This total would make a system of 600,000 mi., of which one-third at least has been improved and from 300,000 to 350,000 mi. remain yet to be improved. Even with this immense mileage under improvement there will still be approximately 2,000,000 mi. of unimproved roads in the United States.

Suspend New Road Construction in Minnesota

The Commissioner of Highways of Minnesota has sent out a request to all county officials to make no more contracts for roads this season, unless to complete sections of work already started. This request is virtually an order, as the counties, in order to get State and National aid, must have the approval of the Highway Department on such work.

One Texas County To Open Bids on $5,000,000 Road Job

According to information recently received from W. H. Eccles, its engineer, Eastland County, Texas, will, May 31, open bids for the construction of 215 mi. of highways, total cost of which will approximate $5,000,000. Durable pavements will consist of bituminous macadam, brick or concrete. Considerable sand-clay construction is also included.

Favor Public Works Department

Through the efforts of the Engineers' Society of St. Paul, the St. Paul Association of Public and Business Affairs has voted on the questionnaire of the National Chamber of Commerce in favor of a department of public works, after receiving an adverse report from its legislation committee. At the meeting of the Society, May 10, Herbert Hoover was indorsed for President.

Col. W. J. Wilgus Heads New York Section, Am. Soc. C. E.

Colonel W. J. Wilgus was elected president of the New York Section of the American Society of Civil Engineers at the annual meeting of that organization in New York City May 12. The other new officers are: first vice-president, R. S. Parsons; second vice-president, J. P. H. Perry; secretary, W. T. Chevalier; treasurer, F. C. Noble; directors, O. E. Hovey and R. H. Chambers.

In adopting a part of a special committee report the section decided to hold meetings the second Wednesday of the month from October to May inclusive. The last meeting of the year will be the annual meeting. The special committee appointed to report upon the time of meeting recommended that a certain number of sessions during the year be held jointly with the local branches of the other founder societies and that meetings be held as early as 5:30 p.m. Though discussion indicated it to be the wish of those present that meetings should be held early, decision as to the time, and number of meetings to be held jointly with other local engineering sections was left to the Board of Direction.

The New York section now contains 248 members, making it the largest local section of the American Society of Civil Engineers.

A. A. E.'s Attitude on Organizing Conference Stated

In accepting on behalf of the American Association of Engineers the invitation to participate in the Organizing Conference of engineering societies to be held at Washington, D. C., June 3 and 4, C. E. Drayer, secretary, sent the following letter to the Joint Conference Committee:

Your valued invitation of April 19 to the Organizing Conference of June 3 and 4, 1920 has been received by the American Association of Engineers.

The American Association of Engineers has for six years been engaged in the furtherance of the purpose announced in your kind invitation.

This Association, therefore, accepts your invitation for the purposes outlined herein and will co-operate with your conference in any manner which will promote the welfare of the engineer and the objects of the American Association of Engineers.

In its co-operation with the Organizing Conference the American Association of Engineers must itself discharge the obligation which has been placed upon it by 17,000 professional engineers. This duty cannot be delegated to another organization, no matter how earnest its purposes may be. In accordance with Section E, page 4 of the call, [from which the following matter is *italics* is quoted], which requests an expression of the attitude of the Association toward the proposed organization, we may say:

1. *Non-interference with the interrelations with respect to technical matters, and the maintenance of the autonomy, functions and operations of individual organizations.*

We endorse this provision.

2. *Local affiliation of existing groups of engineers in order to facilitate united action in local questions of public welfare and other matters of common interest.*

This idea is approved.

3. *National association of engineering organizations by means of a national council composed of representatives widely chosen by local affiliations or organizations and by national organizations, meeting annually and acting through an Executive Board.*

We are not in favor of this idea because in our opinion it would duplicate effort and add useless machinery, which would tend to restrict progress along welfare and non-technical lines. Our Association is doing such work at the present time in an efficient manner and our growth proves that results are being obtained. This viewpoint is based on the result of our experience and consequently we do not believe that the organization proposed would be any improvement over existing machinery.

4. *Financial support of such association by contributions from all participating organizations on a basis of membership.*

In view of the above little or no financial assistance from this Association should be expected.

5. *A form of organization which will permit expansion and development.*

It is our opinion that the simpler the machinery for this end, the better same will be adapted to expansion. Our delegates will be in a position to advise on this point.

All acts of our delegates would, of course, have to be approved by the Association.

Mississippi Valley Associations Merged at St. Louis

Affiliation of the Mississippi Valley Waterways Association with the Mississippi Valley Association was effected at the recent meeting in St. Louis, the former becoming the waterways bureau of the main association. Officers elected by the Mississippi Valley Association include the following: President, H. H. Merrick, Chicago; vice-president on land reclamation, Edmund T. Perkins, Chicago; vice-president on waterways, James E. Smith, St. Louis; secretary for waterways, Thomas H. Lovelace, St. Louis; executive secretary, J. B. Morrow, St. Louis.

Propose Anglo-American Standards for Rolled Steel Shapes

During 1919 the British Engineering Standards Association undertook the revision of their standards for rolled steel shapes, and following a visit of their secretary to this country they sent a formal invitation to the American Engineering Standards Committee to co-operate in the possible adoption of Anglo-American standards for these shapes. Under the auspices of the American body the following representatives of American societies and official bureaus have been holding conferences:

United States Navy — Commander C. M. Simmers, Lieutenant Commander H. D. Rouzer; *Association of American Steel Manufacturers*—R. B. Woodworth (chairman), G. H. Blakeley, G. E. Thackray; *American Bureau of Shipping*—C. A. McAllister, David Arnott, John Martin; *American Society of Civil Engineers* — J. H. Edwards, J. B. French, H. G. Balcom; *Society of Naval Architects and Marine Engineers*—Fred T. Llewellyn, E. H. Rigg, J. W. Stewart; *Railway Car Manufacturers' Association*—A. E. Ostrander.

On April 27 the committee, which is known as the "Sectional Committee on Steel Shapes" of the joint sponsor bodies, formulated a complete preliminary report for transmission to the British Engineering Standards Association as a basis for discussion on common Anglo-American standards. Criticisms or suggestions will be welcomed by the committee if addressed to Dr. P. G. Agnew, secretary, 29 W. 39th St., New York City.

Highway Traffic Association Holds Annual Meeting

Election of officers, and the reading of various reports and three papers relating to the motor truck and the highway, marked the annual meeting of the National Highway Traffic Association, held March 13, at the Automobile Club of America, New York City. Papers were presented by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City; T. H. Aspell, manager, truck tire sales department, B. F. Goodrich Rubber Co.; and H. Eltinge Breed, consulting highway engineer.

The officers of the association were re-elected. They are: President, Arthur H. Blanchard; vice-presidents, David Beecroft and R. C. Hargreaves; treasurer, George H. Pride; and secretary, Elmer Thompson. The following directors were elected: For Connecticut, S. W. Taylor; Delaware, T. Coleman duPont; for District of Columbia, W. P. Eno; Illinois, W. T. Beatty; Indiana, Tom Snyder; Massachusetts, Charles Henry Davis; Michigan, Roy D. Chapin; Missouri, F. W. A. Vesper; Nebraska, George W. Wolz; New Jersey, S. P. Leeds; New York, Col. Jefferson deMont Thompson; North Carolina, R. J. Corbitt; Ohio, F. A. Seiberling; and Wisconsin, Philip A. Koehring.

Committee Organized to Study Housing Situation

Organization in Washington, D. C., of the Calder committee, which is to make a study of the building and housing situations has been completed. W. F. Miller, of New York, has been retained as assistant to the committee and will be in immediate charge of its activities. The principal object of the committee is to find means for stimulating construction. The exact program which the committee will follow is in the course of formulation.

Power Company to Float $5,000,000 Bond Issue

The Southern California Edison Company of Los Angeles, Cal., has been authorized by the California Railroad Commission to issue $5,000,000 of 6 per cent 25-year gold bonds with which to finance extensions to the hydro-electric system. The company stated to the Commission that it proposed to expend $8,500,000 between March 1 and Dec. 31, 1920. Of this amount more than $4,000,000 will be expended on tunnels and power plants in the Kern River and Big Creek generating systems.

A. S. M. E. to Hold Annual Meeting

The American Society of Mechanical Engineers will hold its annual spring meeting in St. Louis, Mo., May 24-27, with headquarters at the Hotel Slatter. The committee on meetings and program, in addition to the usual technical sessions, has planned for excursions to the water-power development on the Mississippi at Keokuk, and to Tulsa, the "hub" of the industrial Southwest. There will also be an opportunity to visit several of the leading industrial plants of St. Louis.

The technical features will cover a variety of topics—Mississippi River transportation problems; housing; appraisal and valuation; pulverized coal uses; aeronautics; and foundry work.

New Jersey Highway Department to Combat Truck Overloading

The overloading of motor trucks has reached such an alarming stage, as judged by the effects upon state highways, that the New Jersey Highway Commission has decided to install scales in various parts of the state to weigh the trucks and contents. The highway department will purchase three sets of scales which it will pay for by moneys obtained through fines and from increased license fees where the vehicle is found carrying a load exceeding that for which it is licensed. The highway department believes that in some cases trucks have carried gross loads 15,000 lb. in excess of the amount specified in the license and of the loads allowed by law. Representatives of several counties of the state have appeared before the board and asked that work be hurried on highways seriously damaged during the past winter.

Activated-Sludge Experiments at Champaign-Urbana

Tests of sewage treatment processes are being arranged by the State Water Survey Division of the Illinois Department of Registration and Education, under the direction of Edward Bartow, Chief of the Division. It is proposed to install at first a 100,000-gal. activated-sludge plant complete in every particular required to yield a good effluent and dried sludge. The experiments will be directed particularly to securing information on the reduction of the amount of air used and on how the sludge can be economically dried.

The City Council of Champaign will permit further use of the old sewage tank employed in earlier experiments together with adjacent land. Separate tanks are being built and the old tank may be used for some other experiment. Various manufacturing companies interested in either developing the activated-sludge process or else in the promotion of the use of plants or apparatus for that purpose have volunteered to supply portions of the necessary equipment either without charge or at reduced prices.

The Department of Municipal and Sanitary Engineering, and also the Engineering Experiment Station of the University of Illinois, are much interested in the proposed experiments and their co-operation is expected. Various sanitary districts in the State of Illinois will co-operate in the experiments.

Engineering Council Votes on Public Works Referendum

In the referendum on a National Department of Public Works conducted by the Chamber of Commerce, U. S. A., Engineering Council voted as follows on the three questions propounded:

1. "Shall a Department of Public Works be established by the national government?"—In favor.

2. "Shall a Department of Public Works be established by a suitable modification of the existing Department of the Interior, excluding therefrom the non-related bureaus and offices and by change of name from Department of the Interior to Department of Public Works?"—In favor.

3. "Shall a Department of Public Works be established by creation of an entirely new department?"—Opposed.

Washington Zoning Work Starts

Work on zoning the District of Columbia began last week with the arrival of Harland Bartholomew, city plan engineer, St. Louis, who has been engaged as consultant by the Zoning Committee, headed by Lieutenant-Colonel C. W. Kutz, engineer commissioner of the District of Columbia. Under the Congressional act that authorizes zoning the work must be completed by Sept. 1. The limiting height of business houses is now 160 ft., and on ordinary business streets, 110 ft. Residences are ordinarily limited to 85 ft.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

ORGANIZING CONFERENCE of National, State and Local engineering societies; Washington, D. C., June 3-4.

The Jackson (Mich.) Engineering Society, at its first annual meeting, held recently, elected the following officers: President, Howard C. Corwin; vice-president, Tony Obuchowski; secretary, Chauncey A. Bullard; treasurer, R. E. Robinson. The society was formed a year ago to meet the demands of local engineers for an organization which would take up problems confronting them in their everyday work. Meetings are held every two weeks.

The Engineers' Society of Pennsylvania, Harrisburg, has nominated the following for officers for the coming year: For president, W. Grant Rauch, Harrisburg; first vice-president, W. R. Denehey, Harrisburg; second vice-president, R. Boone Abbott, Reading; resident directors (to serve three years), R. L. Gillispie and William D. Uhler, Harrisburg; non-resident director (to serve three years), Gifford Pinchot, Milford; secretary, Howard E. Moses, Harrisburg; treasurer, John C. Herman, Harrisburg. All ballots must be received before 8 p.m., on May 17, the date of the annual meeting.

PERSONAL NOTES

A. A. MATTHEWS, chief engineer of the St. Louis Southwestern Ry., Tyler, Tex., is now in charge of all engineering, maintenance and construction work, the office of engineer of maintenance having been abolished. C. B. PETTICREW has been appointed division engineer, at Illmo, Mo. Other division engineer appointments are as follows: W. H. RALEIGH, at Pine Bluff, Ark.; J. F. MONTGOMERY, at Mt. Pleasant, Tex., and R. B. ALBAUGH, at Tyler. J. G. IRBY has been appointed assistant engineer, at Mt. Pleasant; V. C. NOLL at Tyler, and W. G. HAZLEWOOD at Illmo.

R. G. KENLY, general superintendent of the Minneapolis & St. Louis R.R., under Government control, has been appointed assistant to the president and chief engineer. L. C. MILLER, recently office engineer, has been appointed assistant chief engineer and will have charge of valuation work. R. C. SMITH, recently assistant engineer, has been appointed principal assistant engineer, in place of F. K. BENNET, resigned.

WILLIAM C. MARKHAM has resigned as superintendent of construction for New York State Architect and has been appointed chief engineer of the Detroit Municipal Railways, in charge of the construction of that city's new street car lines provided for by a recently passed $15,000,000 bond issue.

JOHN IRWIN has resigned as city engineer of Mt. Clemens, Mich., to take up private practice.

FREDERICK G. COTTRELL, chief metallurgist, has been nominated by President Wilson as director of the U. S. Bureau of Mines, to succeed Van H. Manning, whose resignation will take effect June 1.

E. K. CORTRIGHT has resigned as chief engineer of the Morgan General Ordnance Depot, to join, as a partner, the firm of John Noble Pierson & Son, architects and engineers, Perth Amboy, N. J.

GEORGE ENGEL, commissioner of public works of Detroit, has resigned to go into private business in that city.

C. L. B. SANDERS, who has been employed recently in connection with sewer extension for Gainesville, Ga., has been elected city engineer.

E. A. FONDA, contractor, of Greenville, S. C., will shortly establish offices in New York City and Atlanta, Ga. Sanford N. Mapes, formerly superintendent with McKim, Mead & White, now general superintendent for Mr. Fonda, will have supervision of the Atlanta office, which will direct the Georgia, Florida, Alabama and Mississippi operations.

ORLANDO K. MORGAN, engineer of maintenance-of-way, Carolina, Clinchfield & Ohio R.R., has been appointed chief engineer.

CARL C. WIDENER has resigned as city engineer and superintendent of public works of Bozeman, Mont. He will continue his work on improvements for the city, however, under a new arrangement which will give him also sufficient time to devote to private business.

NORMAN HATTON, S. E. HOLMES and C. B. ANTHONY announce that, owing to the withdrawal of WILLIAM J. KLEIN from their firm, they have formed a new partnership under the name of Hatton, Holmes & Anthony. They will practice architecture, general engineering, machinery layouts, heating and ventilating and industrial engineering, with offices in the Masonic Temple, Cedar Rapids, Iowa.

A. R. SCOTT, engineer of Spokane County, Wash., and E. C. WOOD, deputy engineer, have recently resigned. Mr. Scott is taking care of interests in the oil fields at Roundup, Mont. H. S. BAKER, principal assistant engineer of construction, has been appointed county engineer to succeed Mr. Scott.

COURTNEY C. WASHINGTON, resident engineer, Gulf, Colorado & Santa Fe Ry., at Galveston, Tex., has been appointed Galveston County engineer to succeed R. M. Sias.

STUART M. MILLER, formerly with the Chicago, Burlington & Quincy R.R. on field layouts for the Chicago freight terminal project, is now with H. L. Stevens & Co., in charge of purchasing, receiving and inspecting local materials used in the construction of a new hotel at Norfolk, Neb., and of the field layout of the building.

RICHARDSON & GAY is the name of a new consulting firm composed of Edward B. Richardson, formerly of Richardson & Hale, consulting engineers, who served in the war with the 26th Division and was discharged from the Army as lieutenant-colonel of Field Artillery, and Harry Gay, for the past nine years in the Boston office of Stone & Webster in its division of construction and engineering. The firm's address is 220 Devonshire St., Boston.

S. C. WHIPPLE, for some time past connected with the engineering staff of the California State Water Commission, has been named one of the assistant state engineers. His headquarters will be in Sacramento.

GEORGE J. BOUTELLE has been elected city engineer of Chester, Pa., in place of B. G. Ladomus, for a term of four years.

J. C. MEACHAM, formerly assistant road engineer, Brooke County, W. Va., has been appointed engineer of road construction in Clay District, Marshall County, W. Va., with headquarters at Moundsville.

GIDEON F. BARSTOW, formerly city engineer of Stillwater, Minn., and for the past two years engineer in charge of road construction in Clay County, has resigned to become location engineer of St. Louis County, Minn.

JAMES L. SHIELDS, formerly with the Johnstown (Pa.) Water Co. and later in the construction department of the Cambria Steel Co., has entered the engineering and construction departments of the Reading (Pa.) Iron Co.

J. T. PATTERSON has been appointed senior highway engineer, U. S. Bureau of Public Roads, at Missoula, Mont., succeeding C. W. Cheatham.

VIRGIL W. SAMMS, city engineer of Pocatello, Idaho, and HARRY ORR, an employee of the city water department, have resigned to form a partnership as consulting engineers in Pocatello. John Neville, assistant city engineer, has been appointed city engineer to succeed Mr. Samms.

LIEUTENANT-COLONEL G. S. SMITH, U. S. Geological Survey, is in Dayton, Ohio, assisting in the conduct of tests of airplane cameras to be used in survey work.

W. A. BOWDEN, chief engineer, Department of Railways and Canals, Ottawa, has been re-elected, by the Canadian Government, consulting engineer in reference to the International Joint Commission on the question of the further improvement of the St. Lawrence River between Montreal and Lake Ontario.

J. A. REDFIELD has been appointed assistant engineer of maintenance, Chicago & Northwestern Ry., at Omaha, Neb. D. ROUNSEVILLE has been appointed assistant engineer of maintenance, at Chicago. C. J. FREDERICI, general inspector of bridges, has been appointed division engineer, at Fond du Lac, Wis. Other recent appointments and transfers as division engineers are as follows: H. M. SPAHR, Green Bay, Wis.; H. G. LENNOX, South Pekin, Ill.; T. J. IRVING, Boone, Iowa; M. E. THOMAS, Boone; J. A. DYER, Mason City, Iowa; W. T. MAIN, Eagle Grove, Iowa; B. R. KULP, Madison, Wis.; D. K. VANINGEN, Chadron, Neb.; R. D. ANDERSON, Huron, S. D.; C. F. WOMELDORF, South Norfolk, Neb.

A. H. FULLER, for 18 years dean of engineering, University of Washington, and present director of engineering, Lafayette College, has been appointed head of the civil engineering department of Iowa State College. He will take up his new duties July 1. Prof. Fuller will also act as consulting engineer to the Iowa State Highway Commission.

J. W. B. BOWER has resigned as general superintendent, Engineer Branch of the Department of Soldiers' Civil Re-establishment, Ottawa, to accept a position as chief engineer for a Montreal engineering and contracting concern. W. H. GEORGE, assistant to Mr. Bower, will succeed him as general superintendent.

J. DEVEREAU, JOHN CARY REGAN and E. J. BURKE announce that they have formed a partnership to be known as the firm of York, Regan & Burke, located at 1323 N. Clark St., Chicago. As architects and consulting engineers, they will handle concrete engineering, theater construction, buildings, bridges, concrete steel structures, industrial plants, churches and civic improvements.

A. B. COOK has resigned as city engineer of Santa Barbara, Cal., to open, in that city, an engineering office. He will have associated with him Carl Wyant, formerly deputy under him.

FRANK WALLACE, recently in the county engineer's office at Colfax, Wash., has been appointed resident engineer, U. S. Bureau of Public Roads, at Missoula, Mont.

WILLIAM H. GREEN, formerly with the Boise project, has been appointed project engineer, U. S. Reclamation project at Huntley, Mont.

J. A. DUCK has been loaned by the U. S. Geological Survey to the State of Illinois for the purpose of making a special drainage survey of that state.

OBITUARY

HOMER HAMLIN, of Los Angeles, a widely known consulting engineer, died suddenly in Washington May 14, a victim of cerebral hemorrhage. He had just arrived in Washington to attend a hearing before the Secretary of the Interior on the Salt River reservoir project.

JOHN WESLEY HYATT, inventor of the roller bearing named after him and also of a number of other well known mechanical devices and processes, died at Short Hills, N. J., May 10. He was a brother of Isaiah S. Hyatt, to whom a basic patent for rapid or mechanical filters was granted in 1884 and is credited with having done pioneer work in this field as early as 1881. The brothers were associated in various other inventions. Mr. Hyatt was born at Starkey, N. Y., in 1837.

REUBEN A. HARTWELL, an engineer who had engaged in the development of the Erie Canal, died recently at Utica, N. Y., aged 84. When 18 years of age he was associated with his uncle, Daniel R. Hartwell, engineer in charge of the widening operation of the canal in the Oneida district. In 1864 he was made leveler on the Chenango extension, and in 1882 was appointed assistant engineer of the Champlain Canal. At the time of the $9,000,000 appropriation he was assigned to the Mohawk district.

Who's Who in Engineering To Be Published in England

England is to have an engineering "Who's Who." Descriptive material for such a volume to include professional biographies of all prominent British engineers is now in course of collection and preparation for publication. The work is being edited by John E. Sears, M. A., Assoc. M. Inst. C. E.

The work will not only be a biographical list of individual engineers but will include descriptive lists of engineering firms and of industrial firms. According to a statement of its editor, the particulars concerning many eminent engineers and engineering firms have already been received. He promises that the first issue will be very representative. For the list of engineers, information as indicated in the following is being collected for publication: Name, title, branch of engineering, address, telegraphic address, telephone number, year of birth, parentage, marriage, education, training, professional career, present position, chief works, publications, membership in engineering institutions and clubs, and war services. In the case of firms the following is included: Principals or directors and officers, date of establishment and incorporation, capitalization and amount issued, antecedents, warrants and appointments, war services, list of principal manufacturers.

There will be no charge to engineers and firms for publication of their names and descriptions in the volume. The publication is to sell at 21 and 25 shillings.

Ohio Highway Work Blocked by Bond Decision

By a recent decision of the Ohio Supreme Court that the interest on road improvement bonds already issued cannot be increased from 5 to 6 per cent, a large part of highway work in that State, particularly that undertaken by various counties, is temporarily blocked. The court's ruling was made in the test suit which Cuyahoga County commissioners directed the county prosecutor to file against the county auditor compelling the auditor to place the increased interest charge on the tax duplicate of the affected property. This action was pursued after the legislature had authorized a 6 per cent interest on highway bonds. Bonds had been prepared and assessments on property started at 5 per cent in almost every county in the State, but before the bonds were sold the legislature allowed the increased rate of interest and the bonds became unsalable at the 5 per cent rate. The amount of money tied up in highway bonds destined for use in Cuyahoga County alone approximates $2,000,000. Legal procedure necessary in the reassessment of property and in the readvertisement of bonds will prolong the work at least two months, it is estimated.

Asphalt Interests Object to New York's Highway Policy

With reference to the communication from F. S. Greene, state highway commissioner, to the Governor of New York, announcing a suspension of new road construction (see *Engineering News-Record*, May 13, p. 980) J. E. Pennybacker, secretary of The Asphalt Association, has issued a statement from which the following is quoted:

A rather small percentage of state contracts was completed during 1919 and it would be interesting to find out from Commissioner Greene just what percentage was completed. It is also known that he has been unsuccessful in obtaining bidders on several concrete road projects for 1920. If he persists in his adherence to the plan of building only concrete roads, the result will be a large mileage on paper and very few miles in surface.

As contrasted with this probability, it can be stated confidently that there are large contracting organizations ready and capable of taking up and carrying through to completion sheet asphalt jobs. This is due to the fact that during a long period of years large and efficient asphalt contract organizations have been built up in connection with city work and can easily extend their activities to country highways.

The policy of the State Highway Commissioner in throwing everything into concrete has overloaded the concrete contractors, who, for the most part, have come into this field in the last few years. Would it not be better to turn to an established type of pavement with a long record of success, and for which competent contractors are available, and which in any event can be built at far less cost than concrete, than to embark upon the uncertain course of trying to build concrete roads with an utter disregard of the salvage value of macadam?